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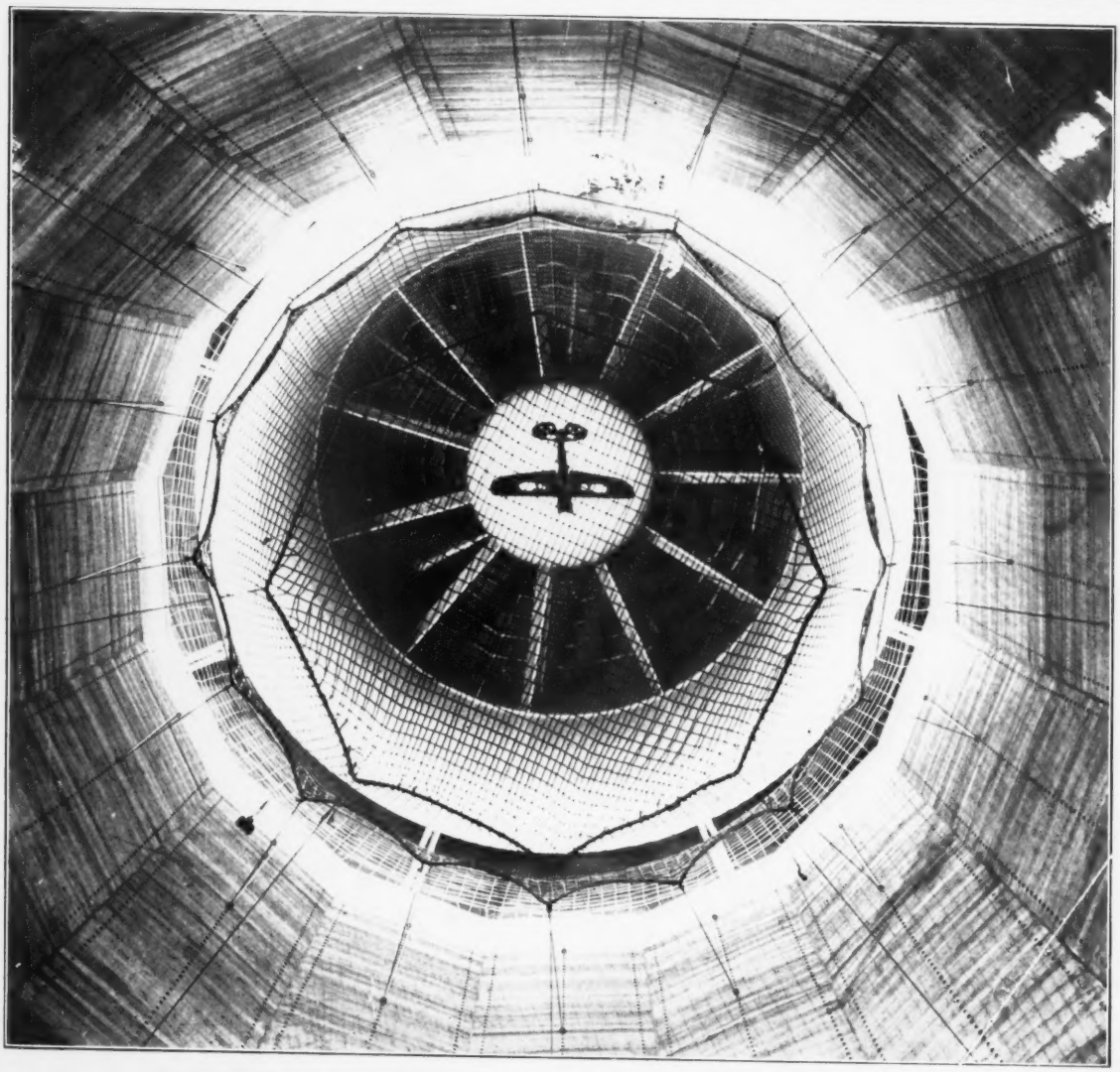
AERONAUTICAL ENGINEERING REVIEW

JANUARY 1945



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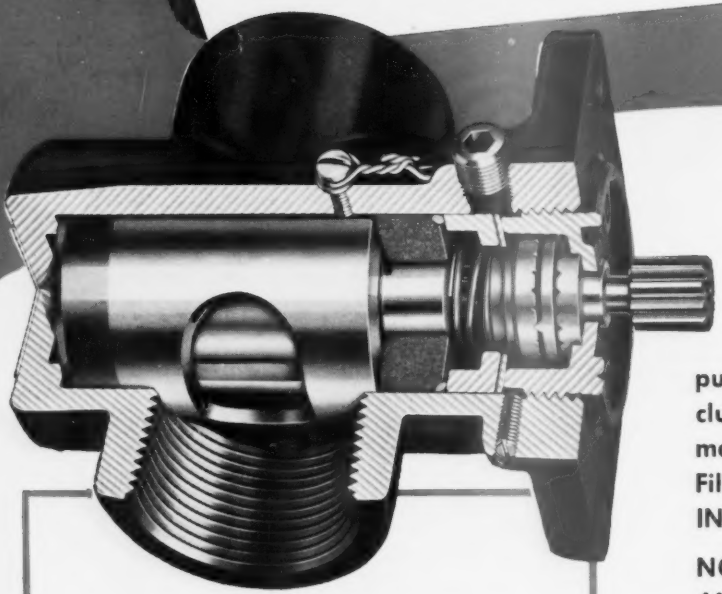
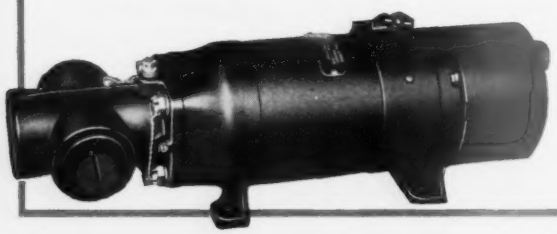


Rated capacity, 900 G.P.H. at 27.5 volts, 14" Hg discharge pressure, 8" Hg inlet suction, 14.5 Amps. Max. Both ports are tapped 1¼" N.P.T.



• You are looking at a photo of a ¾ cutaway view of ROMEC RD-5530 pump used on electric driven transfer pumping unit RD-6100. This unit includes the transfer pump, the G.E. motor and the Sprague Radio Noise Filter. This Unit is used on the BOEING SUPER-FORTRESS B-29.

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SCRAPPY FLOAT PLANE DOWNS JAP ZERO

IN a recent engagement against Jap-occupied *Iwo Jima*, a KINGFISHER Observation Scout Seaplane (OS2U) had been catapulted off a United States cruiser to direct Naval gunfire.

Circling over the island in full view of an enemy airfield, Lieutenant Robert W. Hendershott, U.S.N.R., of Bend, Oregon, pilot of the lightly armed little float plane, calmly proceeded to fulfill his hazardous but vitally important mission.

The slow-cruising Kingfisher looked like an easy mark to the Nip's nest of Zero fighters. Hardly had the surface vessels begun their bombardment, when Hendershott's Observer, Arthur E. Hickman, Aviation Radioman, second class, U.S.N.R., of Denver, Colorado, spotted three Zeros spiralling up.

Rapidly gaining altitude, the enemy planes opened fire on the Kingfisher from below. The lead attacker made a stern approach. Hickman, crouching over his light machine gun, coolly bided his time, and as the fast, heavily armed Zero came within range, let go with a perfectly aimed burst into its engine.

Hickman's bullets must have killed the Jap pilot. For the Zero roared on in—sheared off the Kingfisher's starboard wing tip—and crashed into the sea.

The second Zero came on. Its bullets ripped through the Kingfisher's fuselage within inches of the Navy pilot's legs. The oil tank was punctured. Hot oil spurted over the windshield and cockpit.

Again and again, the two fast and highly maneuverable Jap fighters slammed at the crippled Kingfisher. The fuselage was completely riddled. Finally, Pilot Hendershott maneuvered his plane within reach of the protecting screen of U. S. destroyers and cruisers—and the Jap fliers pulled away!

Score: One Edo float equipped Navy Seaplane damaged. One latest-type Zero knocked into the sea. Two other Zeros badly baffled by a non-combatant observation plane manned by two very combat-minded Navy men. The Japs should file a complaint!

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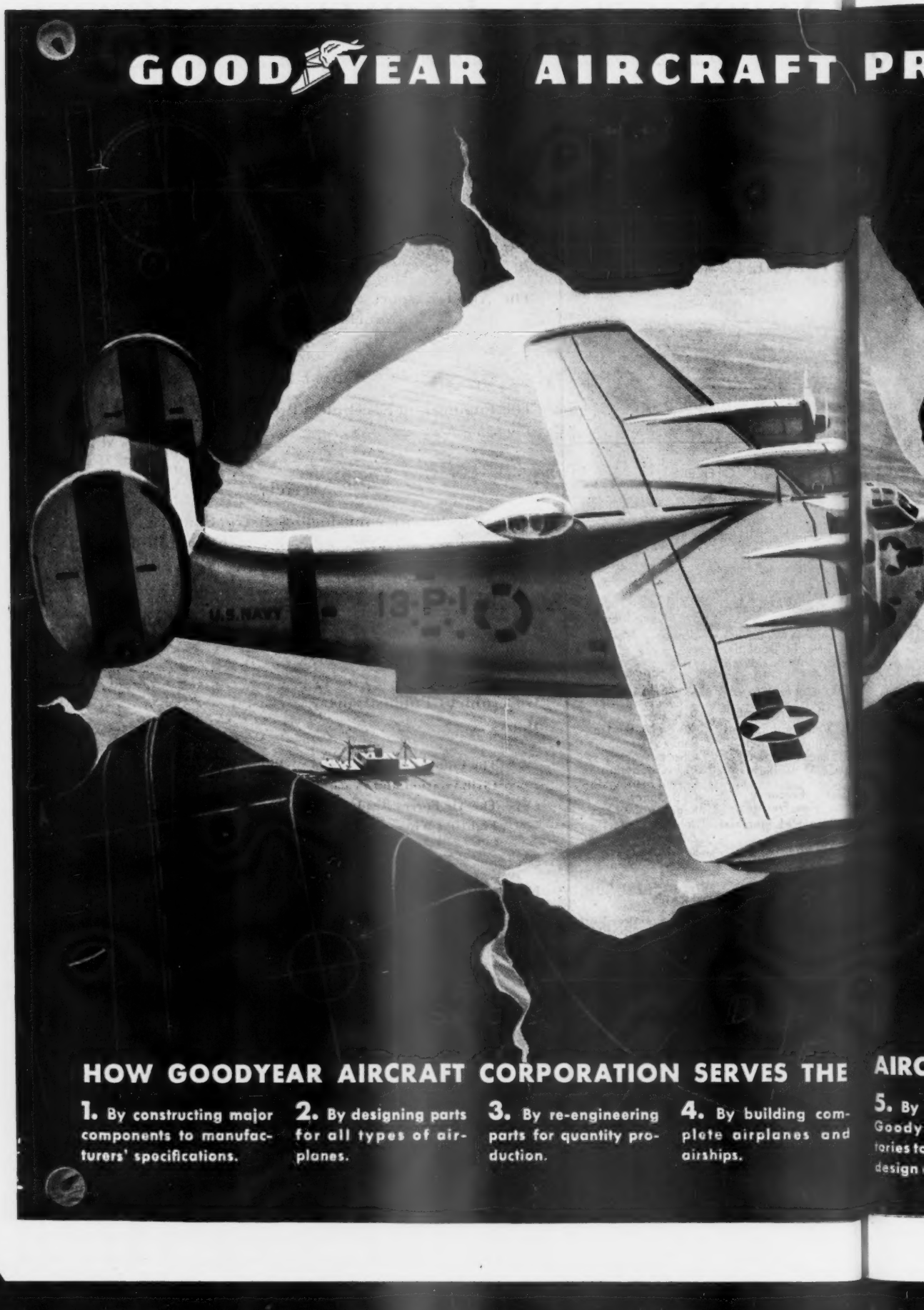
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Goodyear Aircraft's part in making possible the quantity production of these huge four-engined Navy Patrol Bombers (115' wing-spread, 79' length) included the complete re-engineering for production of all above-named assemblies except flight deck. Once re-engineered, Goodyear's ingenuity made it possible for these major components to be produced on time. Record of these big flying boats in the Pacific testifies to the success of Goodyear's share of light metal engineering in solving the complex production and engineering problems.

Goodyear is building components for 16 different Army-Navy types of aircraft, including complete Corsair fighters and Navy airships.

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*Trade Mark

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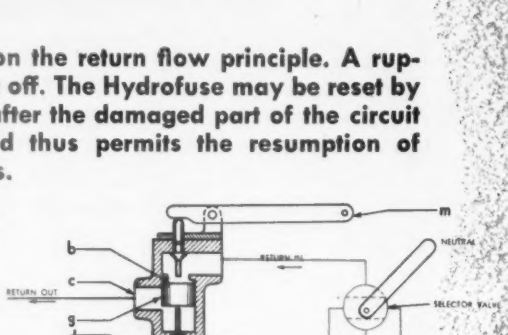
PRINCIPLE OF OPERATION



A check valve (a) is inserted in the pressure line between the power system and the selector valves. A displacement cylinder (e) is placed in parallel with the check valve (a) so that a sample of fluid may be discharged downstream from the check valve even though the valve be closed. When this sample is directed through a selector valve to an operating cylinder, it initiates movement of the piston in that cylinder thus displacing fluid from the other end. This returning fluid enters a small hydraulic cylinder (b) and moves its piston (g) before escaping through port (c) and to the reservoir. The motion of piston (g) is transmitted by push rod (d) to the check valve poppet and lifts it from its seat. Now that the check valve is held open fluid can flow through it and continue moving the operating cylinder piston. If the return line from the operating cylinder had been broken the sample would have moved the operating cylinder piston a small amount but the displaced fluid would have run out the break and thus not acted upon piston (g). Therefore, the check valve would not have been opened and flow of pressure fluid would have ceased as soon as the sample was used.

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The Engineer and Technical Progress

(A Guest Editorial)

WILLIAM B. STOUT*

Consolidated Vultee Aircraft Corporation

THAT THE WORLD has suddenly come into a New Age is no secret to mankind in general. In the short space between the first World War and this, the world has changed from the approach of *opinion and belief* to the necessity of *facts and knowledge*. The world can no longer be run on emotion alone; the technical age has arrived.

It is an age where decisions must be made on the basis of truth, where every investigation instead of attempting to *prove* something must, instead, *find out* something—discover not what one wishes to find but what actually is there.

In today's war, every government has added on to itself hundreds of technical departments, headed by technical men. Those departments that were headed by technical men looking for Truth have made great advances.

The final decision of this war will be determined by the technical men of the winning country; the inventors, developers, engineers, and scientists who fathered radar, landing boats, amphibious craft, aircraft carriers, guns, projectors, robot planes, shells, tanks, and a thousand other things. The Army is merely the channel through which these things flow, and they will win the war on their technical excellence and the scientific knowledge of the groups who build them.

The engineer is, therefore, taking a new place in civilization—he has become the real prophet and sage and prognosticator of human progress, and on his freedom to work and study and create, unhampered by organized ignorance or over-organized intelligence, will depend the future of our country and others.

That country which can best direct its research and creative activity will be the country that rules the world—not by force of arms, not by imposing systems that exploit men, but by devising machines and apparatus that solve the world's problems mechanically and free its slaves from types of work they should not be required to do.

All this will bring new human relations and a new responsibility on the part of engineering, in return for its added importance. The engineer must become something more than a slide rule artist and creator of gadgets.

It takes more than just a knowledge of engineering to make an engineer. It takes more than familiarity with the rules of composition, color, form, and value to make an artist. There is, as has always been recognized, an indefinable something which must go beyond accumulation of knowledge in one's head and skill in one's hands before one can stand in the front rank of his profession.

Try as we may in all of our affairs—financial, political, technical, or otherwise—the human element eventually becomes a part of that activity, and an important one—the relation of our work and activity to our fellow men.

No engineer, no matter how good his knowledge or method of procedure, can be turned loose on a job unless he first be a responsible person. His integrity must be unquestioned; his loyalty must be a part of his job.

If he looks at his daily occupation as work, then he had better spend his time doing something else he would rather do. But if he really knows his subject and can achieve extreme interest in the accomplishment of the impossible, he can have a pleasure from work in engineering or research work which is not approached by any other human activity.

The laws that the Creator put here on earth for us to discover make of us, in turn, possible creators, and in this activity of uncovering the unknown as engineers and of bringing into being finite mechanical creatures of no previous existence, we become in ourselves—at least to the satisfaction of our own ego—creators of new worlds. In creating these new things it is also our responsibility to pass them on to others who might be benefited by their use.

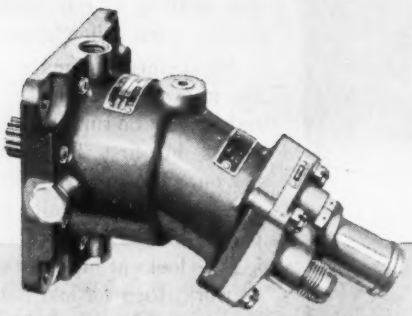
Any beliefs one may have which cannot stand the search of research will not be permanent and are not worth wasting one's time on.

The engineer is in the business of finding out facts, of discovering Truth, of making obvious to the world new lines of better activity and labor, and in the accomplishment of that mission no prophet in the world's history ever stood in a more important position than the engineer of today: the apostle of Truth, the searcher for Facts, the creator of a New Age!

* President, Stout Research Division.

ANSWERING THE QUESTION:

"Should I Use Constant Volume or Variable Volume Aircraft Pumps?"



WHEN TO USE

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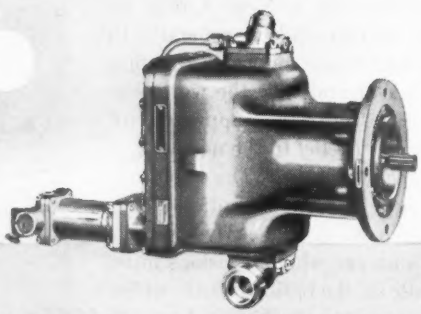
CONSTANT VOLUME

PISTON TYPE PUMPS

This pump requires an accumulator and unloading valve in the majority of aircraft hydraulic circuits. The fixed-stroke pistons deliver fluid continuously to the unloading valve. The unloading valve automatically opens when the accumulator has received and stored its maximum volume of fluid at system pressure; the pump then operates at no pressure by returning oil directly to reservoir. When the accumulator pressure drops to a predetermined minimum, the unloading valve automatically closes and diverts the oil to charge the accumulator. This constant volume pump is recommended when hydraulic power is required for short periods during take-off and landing . . . when operating flaps, landing gear and power brakes. It also supplies any small demand during flight . . . like cowl flap actuators. And it takes care of normal requirements while on the ground . . . including parking brakes and cargo door operation.



WHEN TO USE

VICKERS

VARIABLE VOLUME

PISTON TYPE PUMPS

This pump automatically delivers the volume of fluid required by the hydraulic system. When the requirement decreases, the stroke of the pistons is automatically shortened; when more volume is needed, the piston stroke is automatically lengthened. There is no inlet restriction to cause cavitation. An excess of fluid is *never* pumped. The pump *maintains* full pressure in the system with minimum horsepower. An integral pressure control device automatically and continuously maintains the desired pressure independent of varying volume demand and of engine speed. This variable volume pump is recommended when hydraulic power is used continuously during flight . . . as for power boost flight control, gun turret drive, and cabin supercharger drive.

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Impact-Resistant Windshield Construction

GEORGE L. PIGMAN*

Civil Aeronautics Administration

SUMMARY

This report presents the results of tests carried out by the Civil Aeronautics Administration in which various types of aircraft windshield panel construction were subjected to impact with bird carcasses to simulate the collision of aircraft with birds in flight. A compressed air catapult capable of projecting bird carcasses at velocities from 50 to 450 m.p.h. was used. The first phase of the test program with which the present report is concerned was carried out with flat double-pane, warm air deicing-type windshield panels similar in size to the full Douglas DC-3 windshield.

Bird carcass velocities required to obtain penetration of various glass, plastic, and glass-plastic construction windshield panels are given. It is shown that the type of windshield construction which provides maximum impact resistance with minimum installation weight consists of a fully tempered glass or laminated glass-plastic front pane, with high thermal conductivity for deicing purposes, and a laminated rear pane with semitempered glass face and a thick vinyl plastic interlayer that extends beyond the edges of the glass surfaces and is bolted into the windshield frame. A panel of this type with $^3/_8$-in. vinyl plastic interlayer and weighing 9.0 lbs. per sq.ft., was found to resist the impact of a 14-lb. carcass at a velocity of approximately 200 m.p.h.

Further data are presented showing the effect of different types of windshield mounting upon impact resistance and the effect of temperature and plasticizer content of the vinyl plastic upon windshields incorporating this material. Limited discussion also is given of the effect of angle and location of impact and general windshield design criteria.

INTRODUCTION

THE TECHNICAL DEVELOPMENT DIVISION of the Civil Aeronautics Administration, in July, 1942, initiated a test program concerned with the development of aircraft windshields more highly resistant to collision with birds in flight. Limited work on this problem has been carried out in the past.[1] However, the need for further development was felt by the industry, and by bodies within the Administration, and was accentuated by accident records that indicate that collisions of air carrier aircraft with birds occur on an average of several per week during bird migratory seasons.

The purposes of the development program were:

(1) To determine the types of windshield construction and mounting which will provide maximum resistance to bird penetration for minimum weight of installation.

(2) To investigate methods of design and reinforcement of windshield frames and cockpit structures for high impact strength.

(3) To determine the effect of size of windshield, curvature, temperature, angle of impact, and other similar variables upon impact resistance.

(4) To obtain general design information, including magnitude of forces and energy absorption, for the assistance of aircraft designers.

A general report covering some of the main conclusions of the present work already has been presented.[2] In the present report it is intended to provide specific data and conclusions principally with regard to the first of the objectives mentioned.

In the present investigation it was desired to incorporate in the test panels suitable deicing arrangements, so that windshields that were developed would be satisfactory from both the impact and deicing standpoints. For this reason double-glazed panels adaptable for use with hot air for deicing in general were utilized in the tests. The first phase of the test program, which now is being completed, has been concerned principally with windshield installations similar to that in the Douglas DC-3 airplane. However, in this phase, considerable general information has been obtained which already has been applied to various practical aircraft installations with flat windshields of the approximate size of the full DC-3 panel.

TEST EQUIPMENT AND METHOD OF TEST

The windshield tests have been carried out at the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. A compressed-air catapult is used in the tests for projecting bird carcasses at the windshield panels. With this catapult carcasses from 3 to 16 lbs. in weight can be projected at velocities from approximately 50 to 450 m.p.h.

The chickens and turkeys used in the tests are killed by electrocution just prior to the test, and the carcass is enclosed in a light cloth bag before inserting in the catapult. The carcass is caused to pass through two sets of wire grids at a fixed distance apart after leaving the muzzle of the gun, so that an oscillograph record of velocity of projection is obtained. Bird carcasses from $3^1/_2$ to 16 lbs. in weight are used in the tests to cover the range of weight of large birds with which collisions have occurred in flight.

The test windshield panels are mounted in a standard steel frame, shown in Fig. 1, which simulates approximately the elastic and buckling characteristics of an aircraft structure. It was found impractical to utilize an actual aluminum aircraft structure for the large majority of the tests because of the amount of rebuilding involved, although such a structure is used in the final determination of the impact characteristics of a particular type of windshield construction.

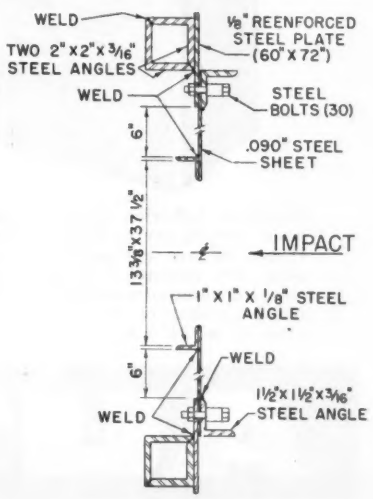

FIG. 1. Steel test frame.

Presented at the Airplane Design Session, Twelfth Annual Meeting, I.A.S., New York, January 25-27, 1944.

* Aeronautical Engineer, Aircraft Development Section.

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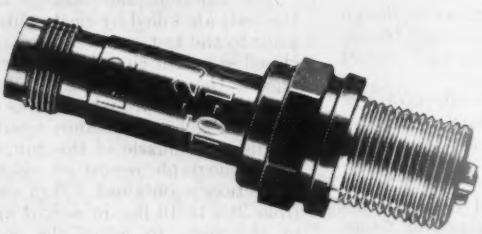

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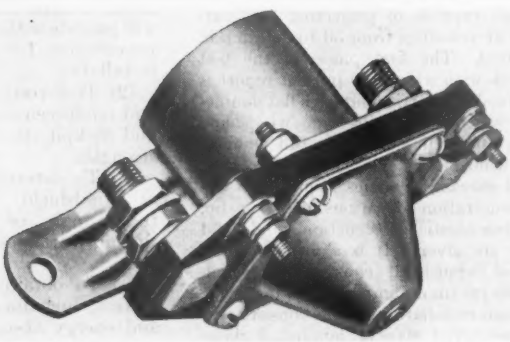

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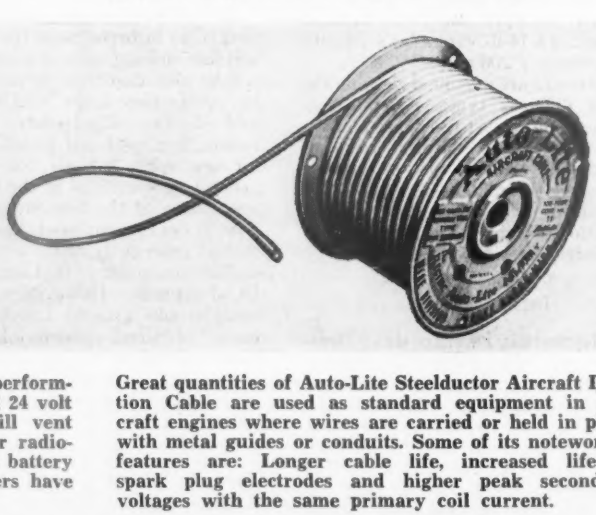

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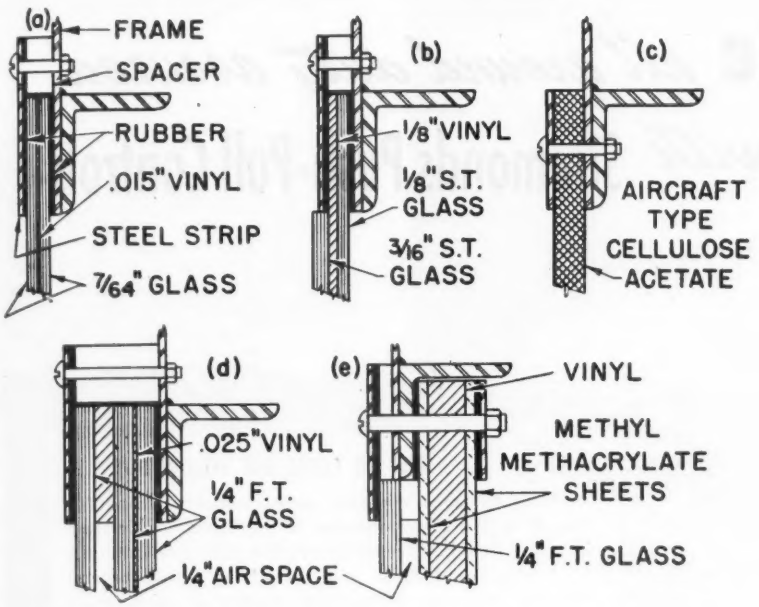

FIG. 2. Windshield types with rigid edge mounting. F.T. = fully tempered; S.T. = semitempered.

RELATIVE IMPACT STRENGTH OF VARIOUS WINDSHIELD TYPES

Some of the various general types of windshield arrangements included in the tests are shown in Figs. 2 and 3, and the penetration velocity determined for each type is shown in Table 1. The penetration velocity is defined as the initial velocity of a bird carcass of given weight at which the carcass will just penetrate the windshield panel.

The penetration velocities given in Table 1 for the different types of windshield construction were determined under identical conditions, namely, for impact at the center point of flat rectangular panels $13^1/_4$ by $37^1/_2$ in. outer dimensions, set at an angle of 38° from a perpendicular to the line of impact in a horizontal plane, and 17° from a perpendicular to the line of impact in a vertical plane. These angles are identical to those at which the Douglas DC-3 windshield is set with respect to the line of flight of the airplane. The tests upon which these penetration velocities are based were carried out with a windshield temperature of 75° to 80°F.

Description of Panel Types

The principal types of windshield construction with rigid edge mounting included in the tests are shown in Fig. 2. Type (a) of Fig. 2 is the conventional safety glass commonly used in present commercial aircraft, and type (b) is a reinforced safety glass similar to that used by several air carrier operators. The aircraft-type cellulose acetate sheet shown as type (c) was included in the tests for general information regarding this material and was not considered a practical windshield for large aircraft in itself. Various types of windshield panels tested with flexible edge construction are shown in Fig. 3. The polyvinyl butyral resin utilized in the laminated panels shown in this figure incorporates a 20 per cent plasticizer content.

The windshield arrangements shown in Figs. 2 and 3 and elsewhere described in this report were suggested by, or worked out in cooperation with, the Pittsburgh Plate Glass Company, the Libbey-Owens-Ford Glass Company, E. I. du Pont de Nemours & Company, Inc., the Rohm & Haas Company, and the Celanese Corporation of America during the course of the tests.

Penetration Velocity for Various Panel Types

The penetration velocity with different carcass weights for the various types of windshield construction shown in Figs. 2 and 3 are given in Table 1. The values of penetration velocity in Table 1 were determined with an accuracy of approximately 10 to 15 per cent, this accuracy being limited by the relatively large spread of test results inherent in glass and plastic samples of this nature, the necessary inaccuracy of definition of the penetration velocity, and the

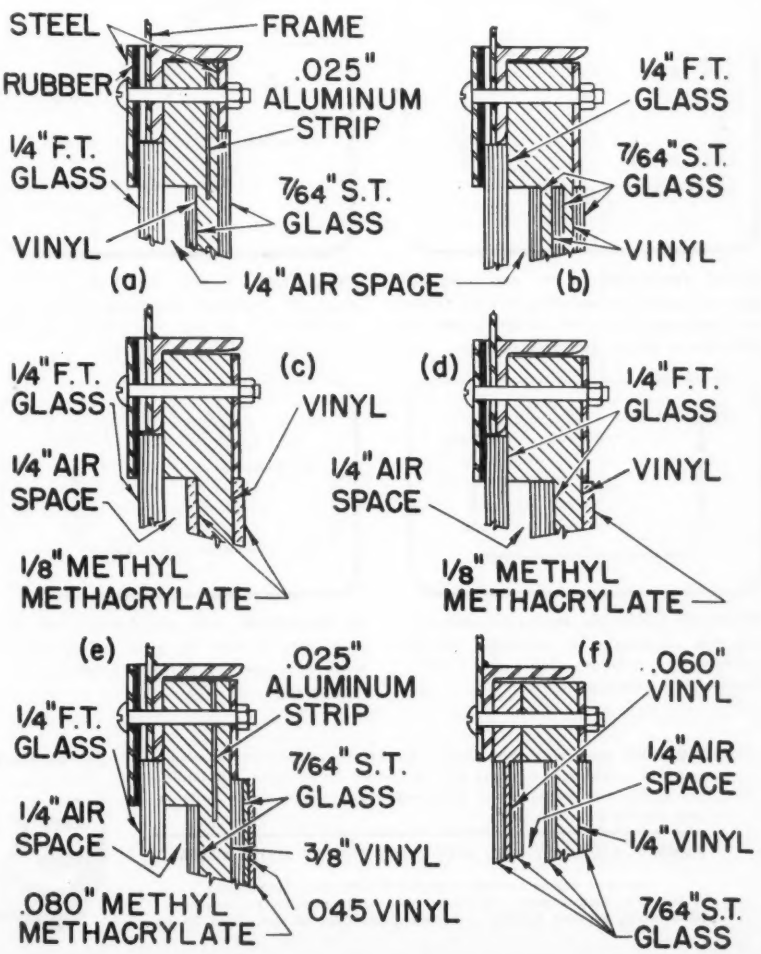

FIG. 3. Windshield types with flexible edge mounting.

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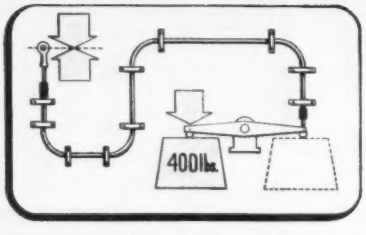
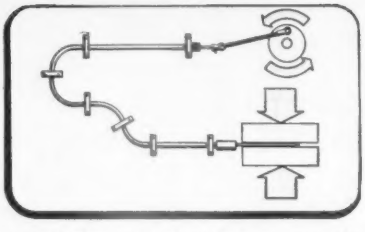
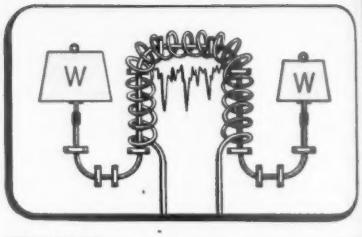


STATIC STRENGTH: *In this test Simmonds push-pull control successfully withstands tensile and compressive forces of 400 lbs. Credit simplification of design, improved linkage.*

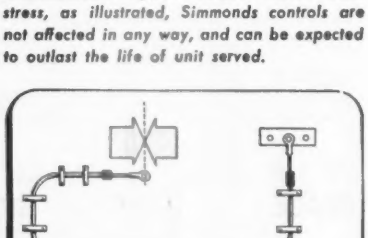


ENDURANCE: *Cycled 30,000 times under stress, as illustrated, Simmonds controls are not affected in any way, and can be expected to outlast the life of unit served.*

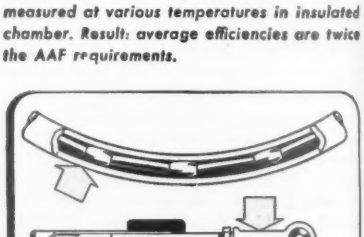


EFFICIENCY: *Input-output ratio of control is measured at various temperatures in insulated chamber. Result: average efficiencies are twice the AAF requirements.*

PRECISION CONTROL: *Motion between tension and compression is negligible. Before endurance test: average—.046", after—.082". Simmonds are precision-built controls.*



DEFORMATION: *AAF specifications call for loads ranging from 10 to 50 lbs. Allowable average deformation is .140". Simmonds controls average only .083".*



CORROSION: *Simmonds controls meet AAF specifications for corrosion resistance with standard cadmium plated or anodized surfaces. Tube ends are rubber sealed.*

INQUIRIES concerning War Contracts or Post-War problems involving push-pull control equipment are invited. Our service engineers will furnish you gladly with analyses and recommendations. Telephone or write to your nearest Simmonds office.

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comparatively small number of tests which could be made on each windshield type in a practical test program. In general, four tests of each panel type were carried out.

Discussion of Windshield Types

General

It is seen from the test results shown in Table 1 that the conventional safety-glass windshield mounted at the angle used in the tests will fail under the impact of a bird carcass 4 lbs. in weight or greater at a velocity below the normal landing speed of present commercial aircraft. It further is noted that no type of windshield tested which utilized either a rigid clamped or bolted mounting will resist impacts of large birds of 14 lbs. weight at cruising speeds of such aircraft. The test results clearly show that the type of construction incorporating a laminated rear panel with vinyl plastic interlayer and with extended plastic edges bolted into the supporting frame provides the maximum resistance against bird penetration for the least weight of installation.

The reasons for the relative advantage of the extended plastic edge type panel are revealed by a study of the mechanism of the impact and windshield failure.

Mechanism of Failure of Front Deicing Pane

The initial impact of the carcass upon the fully tempered glass panel results in complete shattering of this panel at carcass velocities above approximately 100 m.p.h. The velocity at which this failure occurs appears to be independent of the mass of the bird carcass within the range from 4 to 16 lbs. Failure of the fully tempered front panel always occurs as complete shattering of the glass into small approximately cubical pieces, typical of the failure of such glass.

At carcass velocities greater than that at which failure of the front panel occurs, the front panel appears to contribute little to the impact strength of the complete windshield assembly.

Cracking of the front fully tempered glass is shown in Figs. 4, 5, 6, and 7. Fig. 4 is a high-speed photograph taken from the front of the windshield at the instant of impact, the vertical black lines shown being inscribed on the face of the glass previous to the test. Although no bending of the front glass is observable, propagation of the cracks in the front pane has extended to the edge of the frame. Figs. 5, 6, and 7 are enlargements of successive frames of high-speed motion pictures taken at a rate of approximately 1,000 per sec. These pictures were taken from the rear of windshields, all of which incorporated a fully tempered glass front pane. In Fig. 5 the horizontal and vertical lines are placed on the rear face of the rear pane and the diagonal lines are placed on the front face of the front pane. In the first frame shown in Fig. 5, cracks in the front glass already have spread approximately 5 in. from the center of impact. In Figs. 6 and 7 the vertical lines are placed on the rear face of the rear pane, and diagonal lines are placed opposite to each other on the rear face of the front pane and the front face of the rear pane to indicate relative motion.

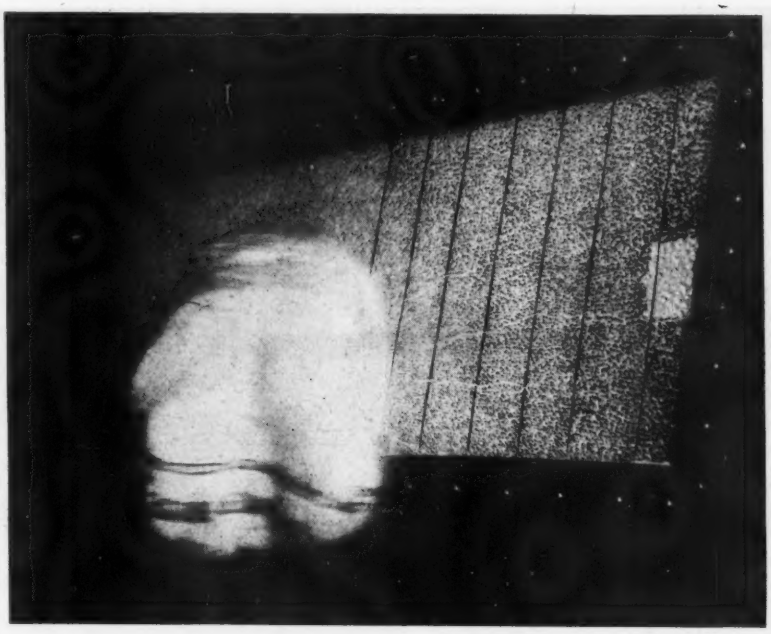


Fig. 4. High-speed photograph of impact of 14-lb. carcass upon full-tempered glass front pane. Velocity of carcass, 153 m.p.h.

It is seen from these figures that local bending and cracking at the point of impact occurs in the front pane within 0.001 sec. after initial contact with the front pane by the bird carcass, and, from the known velocity of propagation of cracks in glass[3] of approximately 5,000 ft. per sec., complete failure of the front pane results within approximately 0.0003 sec. of the initial local cracking. Failure of a front fully tempered glass deicing pane occurs with small deflection of the glass, not greater than the space separating the front and the rear panes and with small resultant energy absorption.

The windshield construction shown as type (f) in Fig. 3 utilizes a laminated front deicing pane with 0.060 in. vinyl plastic interlayer. A front pane of this type possesses slight optical disadvantages and a decrease in thermal conductivity of approximately 20 per cent, when compared to the glass front pane. However, it has tentatively been found in the tests that a laminated front pane of this type, when bolted into the frame through extended plastic edges, will increase the impact resistance by about 15 per cent. Failure of the laminated front pane occurs through initial cracking of the glass surfaces after small deflection, subsequent stretching of the plastic interlayer, and final local failure and opening of the plastic interlayer close to the point of impact.

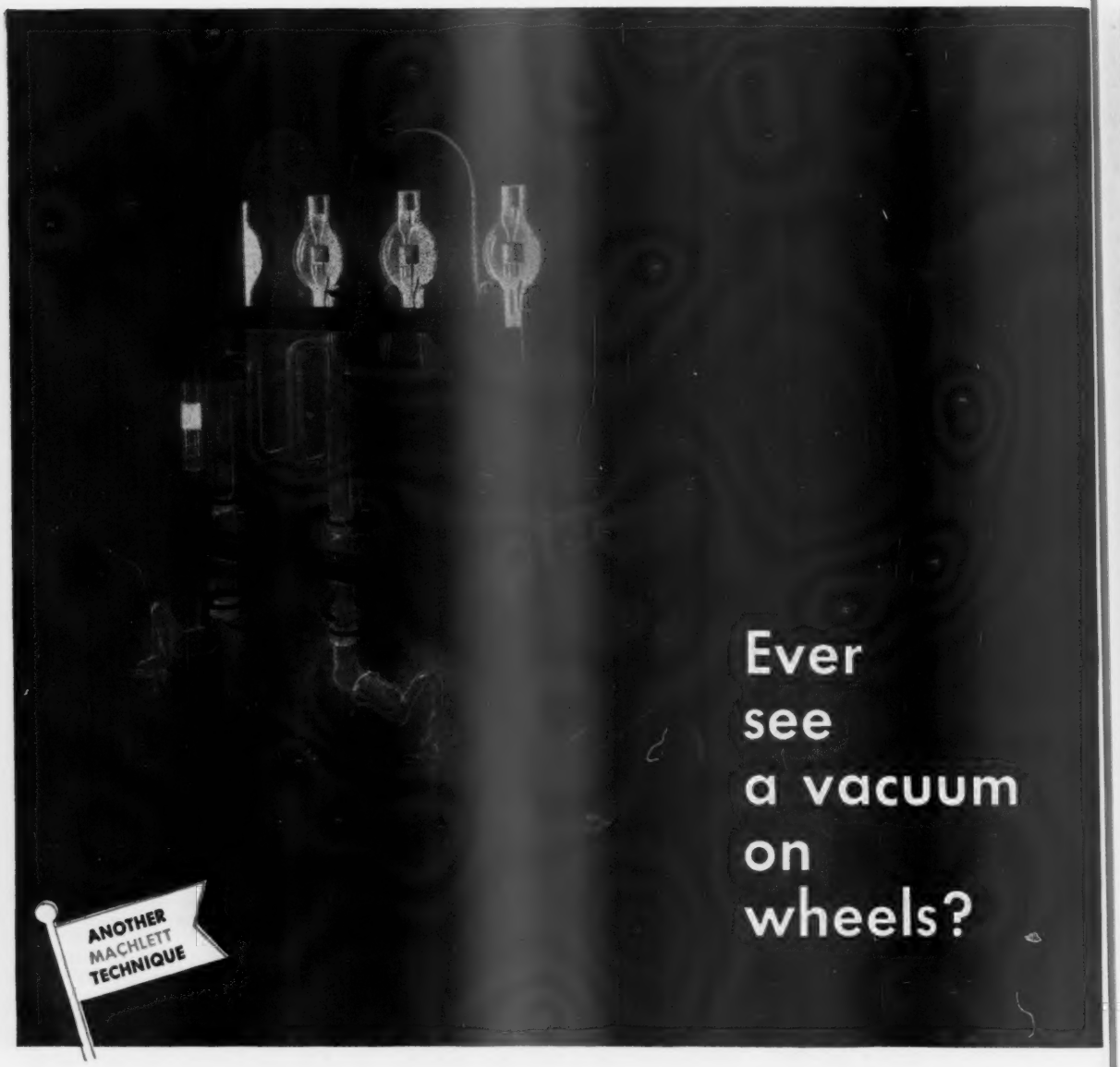
Mechanism of Failure of Rear or Single Panes

The types of rear or single panes included in the tests may be divided into three groups with respect to their action during the impact. These groups are (1) rigid panel construction with clamped edge mounting, (2) all-plastic construction with rigid bolted edge mounting, and (3) laminated construction with flexible bolted edge mounting.

The rigid types of panel construction with clamp mounting in general show the lowest impact strength for a given panel weight. In this group are included types (a), (b), and (d) shown in Fig. 2. Failure of such panels occurs with relatively small deflection, and where a tough plastic interlayer is incorporated as in type (b), final failure occurs by pulling of the plastic sheet from the frame after cracking of the glass has taken place. The test results indicate that if rigidity and strength within the elastic limits of the windshield material is depended upon to resist an impact such as is being considered, the small resultant deflections of the windshield panel leads to extremely high impact forces that require excessive thickness and weight of the windshield installation.

The relatively rigid all-plastic type of panel construction with bolted mounting, such as types (c) and (e) shown in Fig. 2, in general fail after relatively small deflection and by cracking in large fragments in the region of the impact.

In many cases cracks apparently originate from stress concentrations around bolt holes and, subsequently, spread to the center of the panel.



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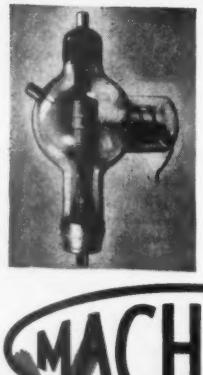

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FIG. 5. Consecutive high-speed photographs of impact of 14-lb. carcass upon full-tempered glass front pane of double-pane windshield. Photographs taken from rear of windshield at approximately 0.001-sec. intervals. Velocity of carcass, 100 m.p.h.

It might be expected that, with the laminated methyl methacrylate-vinyl plastic combination, the methacrylate and vinyl plastics would react independently during the impact and that large deflection of the vinyl interlayer would occur after initial cracking of the relatively inelastic methacrylate surfaces. However, it was found that cracks originating in the methacrylate layers continue into the vinyl material and cause rapid failure of the combination. As will be shown later, this phenomenon does not occur in a glass-vinyl laminated combination.

The general group of windshield panels included in the tests incorporating a laminated glass-vinyl or methyl methacrylate-vinyl construction with extended vinyl plastic edges showed, as a group, the greatest impact resistance to bird collision for a given installation weight. This group includes the various types shown in Fig. 3. The mechanism of failure of panels utilizing this general construction is complex.

High-speed photographs taken of the rear of laminated panels during different stages of impacts are shown in Figs. 8, 9, and 10. Fig. 8 shows the rear of a glass-vinyl panel before large deformation has occurred. Fig. 9 is a similar photograph of a glass-vinyl-methacrylate panel shown as type (d) in Fig. 3. In the tests illustrated in Figs. 8 and 9 penetration of the panel by the carcass was not obtained. Fig. 10 shows four additional high-speed motion picture frames taken immediately subsequent to those shown in Fig. 7. The test shown in Fig. 10 resulted in local penetration of the rear pane at the point of impact.

It has been found that initial failure occurs in the glass surface sheets at a relatively low carcass velocity of 100 to 110 m.p.h. at the angle of impact utilized and with all weights of bird carcass in the range of 4 to 16 lbs. Cracking of the glass originates at the point of impact of the carcass and spreads rapidly across the panel before large deflection has been obtained. It is evident that after such cracking of the glass occurs this material no longer contributes additional strength to the remaining plastic interlayer and can only possibly serve to accelerate final failure by cutting or tearing of the plastic.

The high-speed photographs and other observations further indicate that, subsequent to the failure of the glass surfaces, the plastic interlayer that is bolted into the structure at its edges acts as an independent flexible membrane. Initial deformation of the plastic is of an extremely local and violent nature, occurring within 0.002 to 0.003 sec. and resulting in local deflections of the order of 6 in. for high impact speeds. If local failure of the plastic does not occur at this time, the carcass tends to move toward the rear upper corner of the panel to follow the slope of the windshield. Simultaneously, the local deformation of the plastic rapidly spreads in the form of a wave to distribute the stress to the edges of the panel. Further, during the period of high local deformation considerable quantities of small glass splinters are thrown from the rear face of the panel in this region of high deformation at an apparent velocity of about 500 ft. per sec. Such splinters are observable as a white cloud in Figs. 8 and 10.

A study of the action of the windshield during the impact reveals that final failure of the plastic interlayer may occur through local piercing at the point of impact, tearing of the plastic starting at the point of impact or along the path of the carcass across the panel or through shearing at the edge or tearing at the bolt holes. The nature of a particular failure will be determined by the velocity and mass of the colliding carcass and the thickness of the plastic interlayer.

The action of the vinyl plastic during the impact further is influenced strongly by temperature and plasticizer content, as will be more fully discussed later. High values of temperature and plasticizer content result in increased elongation and decreased tensile strength of the plastic, with resultant greater tendency for local penetration. Low values of these parameters result in brittleness and attendant cracking failures similar to those previously mentioned as obtained with the rigid all-plastic type of panel with bolted edges.

The laminated windshield panels with extended plastic edges but with methyl methacrylate plastic used as surface sheets in place of glass behave, in general, as the glass-vinyl combination during the impact. The plastic on the

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Most of the Laboratories developments, of course, have been in the field of electrical communication. Communication, not simply between individuals as in ordinary telephony, but between mechanisms—as in the electrical gun director. The Laboratories techniques and electronic researches have produced many secret weapons for our country's Armed Forces.

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rear surface around the area of large local deformation shows some tendency to become loosened at the bond with the vinyl interlayer and to be thrown off to a limited extent in fragments 2 to 3 in. in size.

Effects of Variation in Laminated Extended Plastic-Type Construction

A large variety of laminated panels with extended vinyl plastic edges have been included in the tests, some of which are shown in Fig. 3. These variations have included different thickness of the plastic interlayer, thickness and type of surface lamination, and use of multiple laminations.

The variation of penetration velocity with thickness of plastic interlayer for glass-vinyl laminations, arranged as indicated for type (a) in Fig. 3, is shown in Fig. 11. It is noted that a large gain in impact resistance of the rear panel is obtained as the vinyl thickness is increased from $^1/_8$ to $^3/_8$ in., but with thicknesses greater than $^3/_8$ in., little additional gain in strength is obtained. It was found in this connection that with thicknesses of the vinyl interlayer greater than $^1/_2$ in., and with the normal test conditions of 75° to 80°F. temperature and 20 per cent plasticizer content of the vinyl material, the plastic interlayer exhibits decreasing ability to undergo large deformations without splitting.

Various thicknesses and arrangements of the glass components of the glass-vinyl type laminated rear panel were tested. This included the use of $^3/_{16}$-in. semitempered glass or $^1/_4$-in. fully tempered glass in place of the $^1/_8$-in. semitempered glass on the rear face of the type (a) panel of Fig. 3 and multiple laminations with varying plastic thickness such as shown as type (b) in Fig. 3. In general, variations in the glass thickness or arrangement resulted in inappreciable changes in the impact strength of the panel, and changes in the total thickness of the vinyl plastic interlayer produced by far the greatest effect upon impact strength for a given change in weight.

The use of methyl methacrylate plastic in place of glass of equal thickness in the rear laminated panel was found to decrease appreciably the impact strength of the windshield arrangement. This is shown in Table 1 as the difference in penetration velocity obtained with types (3a) and (3c), in this case the $^1/_8$-in. semitempered glass faces of type (3a) being replaced with $^1/_8$-in. methyl methacrylate sheets in type (3c). Increasing the thickness of the methacrylate sheets to obtain a comparison with glass upon the basis of equal weight results in little added strength. However, as indicated by Table 1 and the comparative strengths of various vinyl interlayer thicknesses shown in Fig. 11, maintaining equivalent thicknesses of glass and methacrylate surfaces, but increasing the thickness of the vinyl interlayer to obtain comparison based upon equal weight of the complete panel, will result in approximately equivalent impact strengths.

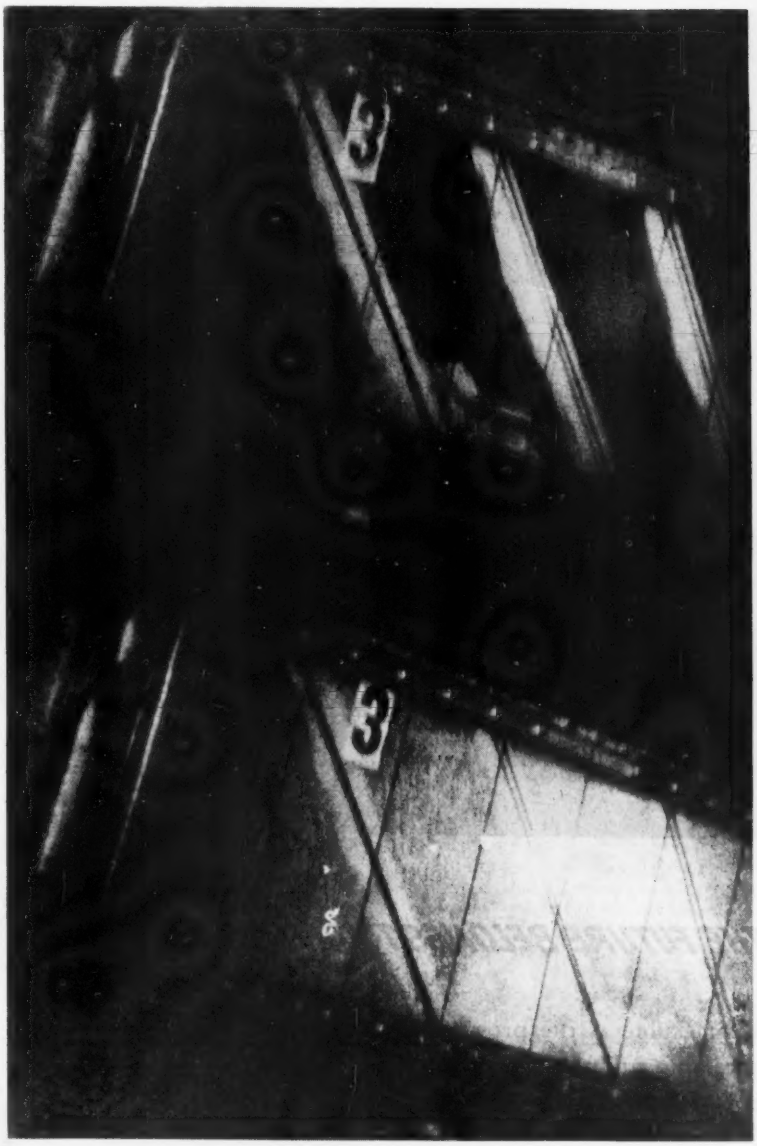


FIG. 6. Consecutive high-speed photographs of impact of 4$^1/_2$-lb. carcass upon full-tempered glass front pane of double-pane windshield. Photographs taken from rear of windshield at approximately 0.001-sec. intervals. Velocity of carcass, 150 m.p.h.

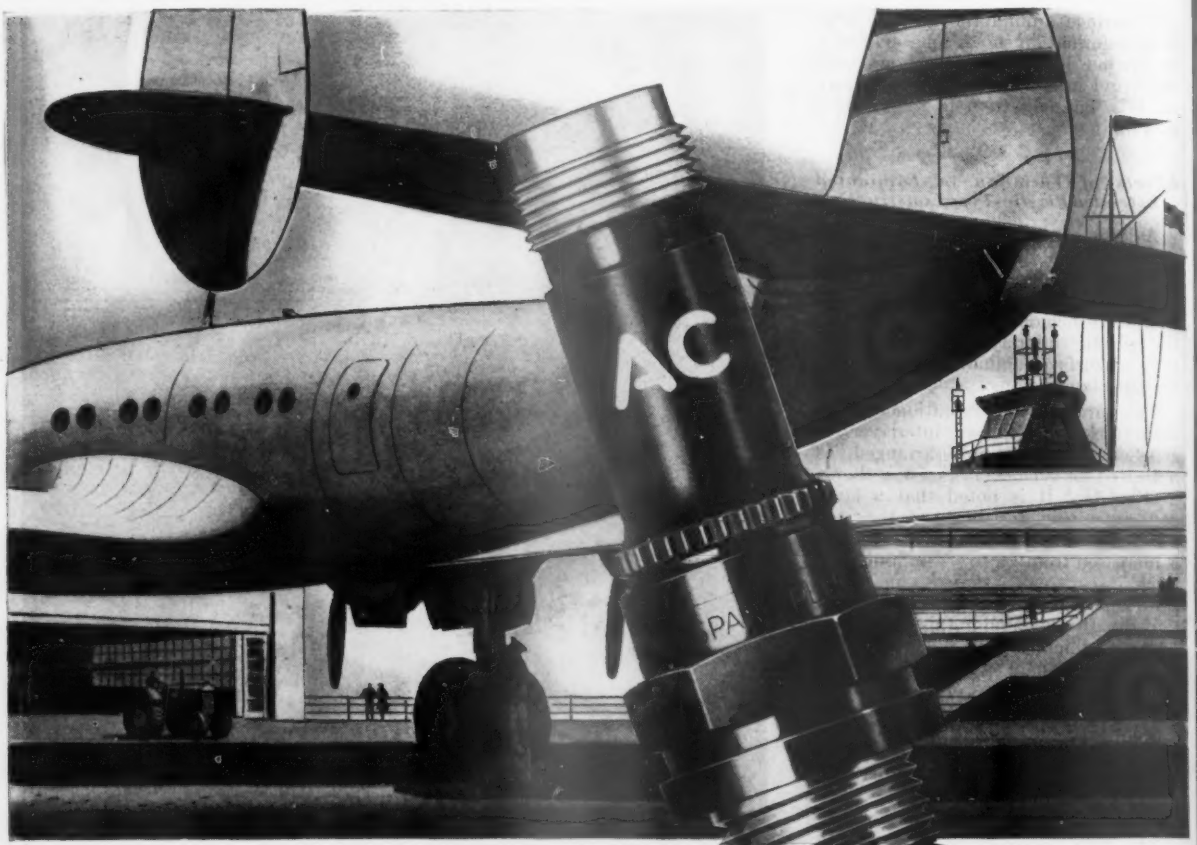
The combined glass-vinyl-methacrylate lamination, shown as type (d) of Fig. 3, was found to possess impact resistance approximately equivalent to the type (a) glass-vinyl panel of equal vinyl thickness but, because of its unsymmetrical construction, exhibits serious bending and optical distortion associated with differential thermal expansion of the glass and plastic.

In general, the simple glass-vinyl type lamination with $^1/_8$-in. semitempered glass faces, shown as type (a) in Fig. 3, with such additions later to be discussed in connection with minimization of glass splintering, was found to provide maximum impact strength for minimum weight and appears to be most satisfactory from optical and other considerations.

Effect of Angle and Location of Impact upon Impact Resistance

A limited number of tests have been conducted to determine the effect of angle of impact upon the impact strength of double-pane windshields utilizing extended plastic edge type laminated rear panels. Data in this connection are as yet incomplete, and further tests to investigate this effect are planned.

In Table 2 is shown the change in impact resistance of double-pane windshield installations with laminated rear pane as the angle of impact is varied from the normal angle of the Douglas



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It will be seen that the effect of angle is greater than would be expected from resolved velocity components alone. This already has been observed in other tests involving impact of soft projectiles upon glass.[4] It further will be noted that, in the particular case considered, impact along the line of flight involving maximum differential speed but oblique angle represents the most severe impact condition.

A further series of tests was conducted to determine the effect of location of impact on the windshield surface upon impact resistance of the double-pane laminated type construction. It was found that small variation in penetration velocity results as impact location is varied over most of the panel surface but that a decrease of about 30 per cent in the penetration velocity is obtained for impact 5 to 6 in. from the outboard end of the windshield. This decrease apparently is associated with high edge forces in this region and with the inability of the carcass to slide away from the point of impact after local deformation.

A small decrease in strength of the panel was noted for impact upon the windshield close to any of the other edges, with an associated increased tendency for edge failure in the region of contact. However, no quantitative measure of this variation could be obtained because of inability to control the location of the point of impact within 3 to 4 in. and the attitude of the carcass as it strikes the panel. Because of such uncontrollable factors the values of penetration velocity given in Table 1 are based upon impacts close to the top and bottom edges of the panel, as well as at the center, and with the carcass striking in various attitudes.

FIG. 7. Consecutive high-speed photographs of impact of 4-lb. carcass upon full-tempered glass front pane of double-pane windshield. Photographs taken from rear of windshield at approximately 0.001-sec. intervals. Velocity of carcass, 155 m.p.h.

EFFECT OF TEMPERATURE AND PLASTICIZER CONTENT OF PLASTIC UPON IMPACT RESISTANCE

The temperature of the vinyl plastic interlayer utilized in the extended plastic edge type lamination is of primary importance in determining the impact characteristics of windshields incorporating such construction. At low temperatures this material becomes brittle with low per cent elongation. At high temperatures the per cent elongation becomes large with decreasing tensile strength. There is shown in Fig. 12 the variation with temperature of the "toughness index" of vinyl resin or the product of the per cent elongation and tensile strength which provides a qualitative measure of the energy absorbing ability of the material. The data upon which Fig. 12 is based were supplied by the Pittsburgh Plate Glass Company.

It is noted from the curve presented in Fig. 12 that an optimum temperature exists at which the energy absorption of the plasticized vinyl resin reaches a maximum and that the energy absorption decreases rapidly at temperatures much lower or higher than this optimum value. Variation of the plasticizer content also is indicated to cause a shift of the curve along the temperature axis. As the data of Fig. 12 were obtained at relatively low rates of loading of the material, it might be expected that with high rate of loading as would be existent during high-speed impact further shifting of the curve along the temperature axis and modification of the peak value would occur but that the general character of the relationship would not be greatly changed.

Tests have been conducted with laminated-type windshield panels utilizing the vinyl plastic interlayer and extended plastic edge over a temperature range from 75° to 140°F. The plasticizer content of the vinyl interlayer was varied from 20 to 30 per cent. It is planned to further extend this range of temperature and plasticizer content in future tests. Results of completed tests are presented in Fig. 13, together with data obtained at elevated temperatures with the $1/_8$-in. thick cellulose acetate sheets shown as type (c) in Fig. 2.

It will be noted that the general type of curve obtained with the panels incorporating vinyl plastic is similar to the curve shown in Fig. 12 for the vinyl material alone. However, the tem-

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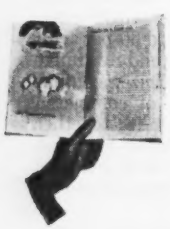

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TABLE 1
Penetration Velocities Determined with Various Types of Windshield Construction

Windshield Type (Shown on Figs. 2 and 3)	Windshield Weight, Lbs. per Sq. Ft.	—Penetration Velocity,— M.P.H. With 4-lb. carcass	With 14-lb. carcass
Type 2(a)	3.4	80	...
Type 2(b)	5.0	100	100
Type 2(c), 3/8-in. thickness	2.5	...	90
Type 2(c), 1/2-in. thickness	3.4	...	90
Type 2(d)	10.1	...	140
Type 2(e), with 1/8-in. methacrylate faces and 1/4-in. vinyl interlayer	6.4	...	<150*
Type 2(e), with 1/8-in. methacrylate faces and 1/2-in. vinyl interlayer	7.9	...	<140*
Type 2(e), with 1/4-in. methacrylate faces and 1/4-in. vinyl interlayer	7.9	...	130
Type 3(a), with 1/8-in. vinyl interlayer	7.5	280	130
Type 3(a), with 1/4-in. vinyl interlayer	8.2	...	160
Type 3(a), with 3/8-in. vinyl interlayer	9.0	...	190
Type 3(a), with 1/2-in. vinyl interlayer	9.7	...	190
Type 3(b), with 1/8-in. vinyl interlayers	9.9	...	180
Type 3(b), with 3/16-in. vinyl interlayers	10.7	...	190
Type 3(c), with 1/2-in. vinyl interlayer	7.9	...	<150*
Type 3(c), with 3/4-in. vinyl interlayer	9.3	...	175*
Type 3(d), with 3/8-in. vinyl interlayer	9.7	...	180
Type 3(d), with 1/2-in. vinyl interlayer	10.5	...	190
Type 3(e)	9.8	...	190
Type 3(f)	8.6	...	185

* Results only approximate because of limited number of tests.

perature at which maximum impact resistance is obtained for the panels with vinyl interlayer of 20 per cent plasticizer content now is seen to be approximately 110°F., with the maximum for the 30 per cent plasticized material occurring at 75°F. or lower. The maximum penetration velocity obtained for each plasticizer content appears to be approximately the same.

It is evident from the data shown that a vinyl resin of particular plasticizer content can be efficiently used over only a limited range of temperatures but that the plasticizer content may be varied to obtain maximum impact strength in any particular reasonable range of temperature desired. It further is noted that the values of penetration velocity given in Table 1 for panels incorporating vinyl resin are increased by approximately 40 per cent if the optimum temperature or plasticizer content is used.

EFFECT OF MASS OF BIRD CARCASS

It is of considerable practical, as well as theoretical, interest to determine by test the effect of varying the mass of the colliding carcass; the order of magnitude of the energy absorbed, respectively, by the carcass, the windshield panel, and the supporting structure; and the magnitude and duration of the impact forces involved. As yet little data in this connection have been secured, and it is planned in future tests to complete more fully such determinations.

Some data, however, have been obtained with regard to the effect of mass of carcass upon the impact resistance of the various types of windshield construction. As seen from the test results given in Table 1, the penetration velocity of windshield panels fabricated principally of glass or other rigid or brittle materials appears to be independent of the mass of the colliding bird carcass within the range from 4 to 14 lbs. The initial failure of the panel is apparently associated with high local penetration forces that are more a function of the velocity of increments of the carcass first contacting the panel than the total momentum or kinetic energy of the colliding mass. That this relationship does not hold for bird weights of the order of 1 lb. or less, however, is indicated by records of collision in actual flight where small birds have been deflected by windshields of this type at high speeds without damage to the glass.

The effect of the mass of bird carcass upon the penetration velocity of windshields incorporating the laminated extended plastic edge type construction, however, is much greater. This is indicated by the test results shown in Table 1 obtained with the type (3a) panel with 1/8-in. plastic interlayer, which was determined to have a penetration velocity of 130 m.p.h. with a 14-lb. carcass and 280 m.p.h. with a 4-lb. carcass.

Insufficient data have been obtained to establish a definite relationship between bird mass and penetration velocity for the extended plastic edge type windshield. However, at present it is indicated that this relationship for a particular panel may be expressed in terms of initial effective kinetic energy

TABLE 2
Penetration Velocities Determined for Various Angles and Locations of Impact
[Type (a) Windshield of Fig. 3, with 1/4-in. Vinyl Interlayer]

Angle of Windshield with Respect to Plane Normal to Line of Impact — Rear horizontal angle	Rear vertical angle	Location of Impact on Windshield	Penetration Velocity, M.P.H.
38°	17°	Center	160
38°	17°	5 1/2 in. from outboard end	110
38°	17°	5 1/2 in. from inboard end	150
11°	17°	Center	120

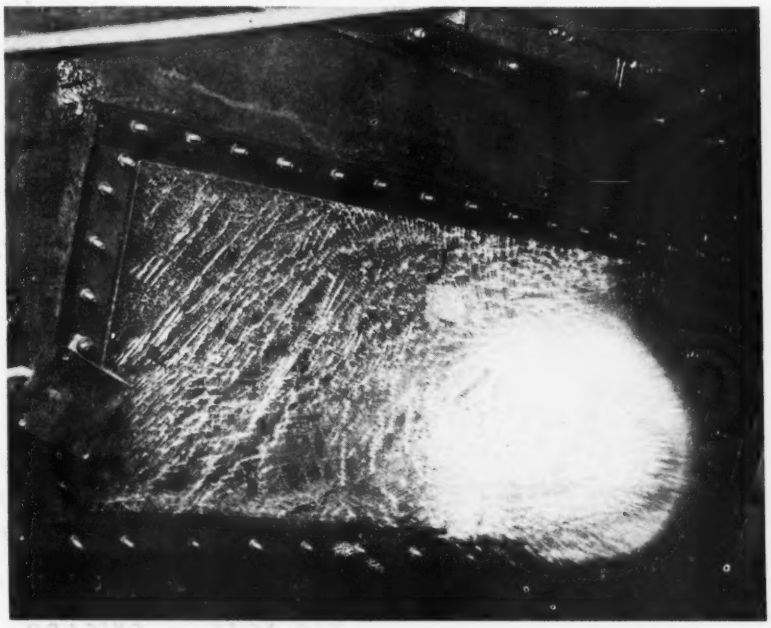

FIG. 8. High-speed photograph of rear of double-pane windshield, with laminated glass-vinyl rear pane (type (a) of Fig. 3), during impact of 15-lb. carcass. Velocity of carcass, 196 m.p.h.

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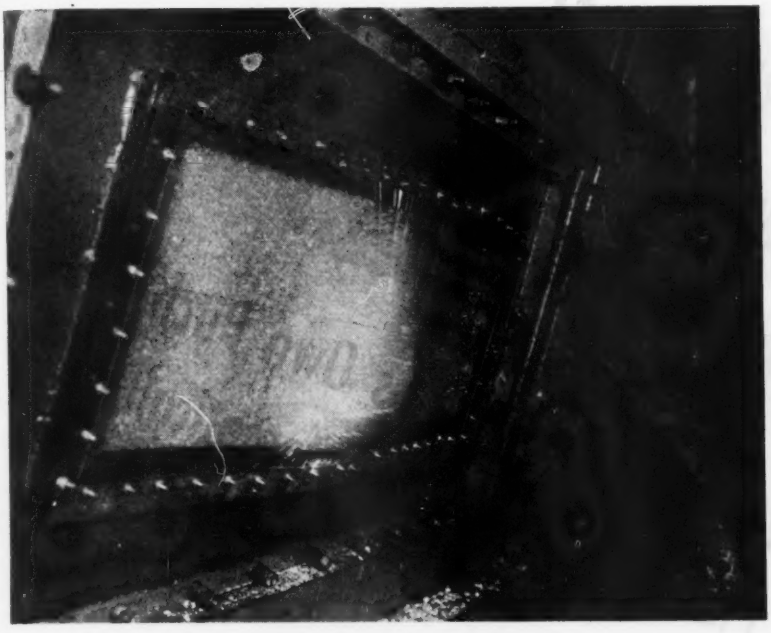

FIG. 9. High-speed photograph of rear of double-pane windshield, with laminated glass-vinyl-methacrylate rear pane (type (d) of Fig. 3), during impact of 12-lb. carcass. Velocity of carcass, 190 m.p.h.

of the bird carcass which is necessary for panel failure. In the expression for effective kinetic energy, the mass of the bird carcass (m) is replaced by a "relative mass" (m'), which takes into account the relative masses of the bird carcass and the panel. Thus, if E is the effective kinetic energy of the bird carcass which will cause failure of the panel,

$$E = m'v^2/2$$

where

$$m' = m/[1 + (M/m)]$$

M = effective mass of windshield panel

v = penetration velocity of windshield for mass (m)

This relationship has been developed from the assumption that the bird carcass possesses a completely inelastic structure, which is indicated by its observed low velocity of rebound from a rigid target, and is found in agreement with the limited data thus far obtained when the effective mass of the windshield M is taken as approximately 25 per cent of the mass of the rear laminated panel of the double-pane arrangement. It is noted that the relative mass of the carcass m' approaches m for small values of the ratio M/m and approaches zero for large values of M/m.

GENERAL DESIGN INFORMATION

In the design of an aircraft windshield installation the designer is generally required to take into account the optical and thermal characteristics of the windshield, as well as consideration of its strength under static and impact conditions. Furthermore, the impact strength of the installation is dependent upon the type of structure surrounding the windshield and the method of mounting the windshield in this structure, as well as upon the windshield construction itself. It is not intended in the present report to present complete data in these connections. The various factors, however, are discussed briefly below insofar as they relate directly to panel construction and characteristics.

Windshield Frame Structure and Panel Edge Mounting

The standard type of mounting used in the tests, as previously described and as shown in Fig. 1, consists of a steel frame with the laminated rear pane retained by bolts passing through the plastic edge. It was found that No. 10 steel bolts spaced at 2-in. intervals completely around the edge of the panel provide adequate retention strength for impacts up to that obtained with a 15-lb. carcass at approximately 200 m.p.h. As noted in Table 1, this strength is approximately equivalent to the strength of the type (3a) extended plastic edge panel with $^3/_8$-in. vinyl interlayer. At this limiting degree of impact, failure of the bolts in tension and shear at local sections along the edge of the panel occurs, particularly when the area of impact is located close to the edge of the windshield opening.

Failure at the edge of the panel also occurs by shearing of the extended plastic edge around the bolt holes. It was found necessary to allow at least $^3/_8$ in. from the centerline of the bolts to the edge of the plastic and to utilize a metal insert of 0.025-in. aluminum in the plastic, as shown in type (a) of Fig. 3, to minimize such failure. It further was found helpful in preventing shear around bolt holes to make the thickness of the plastic edge as great as possible.

Several pertinent points may be mentioned with regard to the effect of design of the windshield frame and cockpit structure upon windshield panel strength.

Data in this connection were obtained by special tests of windshield panels in aluminum cockpit structures supplied by the Douglas Aircraft Company, Inc., tests of the United Air

FIG. 10. Consecutive high-speed photographs taken at approximately 0.001-sec. intervals immediately subsequent to those shown in Fig. 7. Rear windshield pane same as type (a) of Fig. 3.

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It has been indicated by such tests that the most satisfactory methods of windshield support from the standpoint of maximum panel impact strength are, in their order of merit:

(1) Retention of the rectangular laminated rear windshield panel principally at the two ends with bolted mounting through the extended plastic edges. With the two long edges of the panel bolted to a structure relatively weak with regard to buckling, maximum displacement of the panel in bending and maximum energy absorption by the windshield and structure are obtained.

(2) Approximately uniform distribution of mounting bolts and frame stiffness around the entire edge of the panel similar to that obtained with the standard steel frame utilized in the tests.

Deviations from such types of mounting, which may be necessitated in practical design by consideration of ease of removal of the windshield or other factors, may result in decreased penetration velocity of a particular panel type. This is especially true where support of the panel is concentrated along localized sections of the edge.

Minimization of Glass Splintering

The splintering of glass particles from the rear face of a laminated glass windshield panel during impact, as shown in Figs. 8 and 10, may be considered almost as serious a hazard in flight as penetration of the panel by a bird. Tests therefore have been carried out with the objective of determining means for eliminating or minimizing such splintering action.

The various types of windshield panels shown in Fig. 3, which incorporate a methyl methacrylate laminated sheet on the rear face, were tested in this connection. As shown in Fig. 9, production of fine splinters is eliminated completely with this type of construction, although a few relatively large pieces of the methacrylate sheet may be loosened and thrown off from the vinyl core. However, as mentioned previously, it has been found that many panels of such type possess disadvantages with respect to impact strength and also with regard to optical considerations.

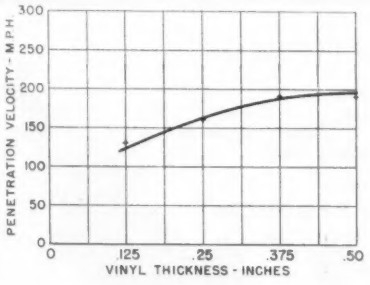

FIG. 11. Variation of penetration velocity with thickness of vinyl interlayer of type (a) windshield of Fig. 3 for 14-lb. carcass (T = 77°F., angle of mounting same as in DC-3 airplane).

Panels of the glass-vinyl construction with an 0.080-in. methacrylate sheet in back of the rear glass face were indicated to be most satisfactory. The plastic sheet may be either bonded directly to the rear glass face with about an 0.045-in. vinyl bonding layer, as shown in type (e) of Fig. 3, or may be supported independently and elastically at the edges in such a manner that large bending deformation of the sheet may occur without cracking being induced. Either of these two types of mounting of the plastic sheet provides a high degree of protection from the splintering hazard. From a practical standpoint separate mounting of the sheet permits greater ease and cheapness of replacement than the bonded mounting, but the latter appears optically superior.

Although the tests show that a plastic rear surface of the windshield is necessary to minimize glass splintering, it should be recognized that a plastic surface is more easily scratched or marred than a glass surface and that more careful maintenance is required.

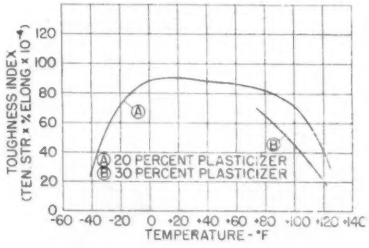

FIG. 12. Variation of "Toughness Index" of vinyl plastic with temperature, as determined at low rate of loading.

Thermal Characteristics of Laminated Windshield Panels

The general importance and specific effect of temperature upon the impact-resisting properties of windshields incorporating a thick vinyl plastic interlayer have already been discussed. However, mention may be made of the application of such data in a practical windshield installation.

In a double-pane deicing-type windshield utilizing a $\frac{1}{4}$-in. fully tempered glass front pane and a laminated rear pane, it has been shown by tests conducted by the National Advisory Committee for Aeronautics[5] and others that the warm deicing air will enter the windshield at approximately 200° F. and will leave the windshield at approximately 100°F. The average temperature of the vinyl plastic interlayer in the rear pane will be of the order of 130°F., with localized portions of the panel being at considerably higher or lower temperatures. As indicated from previous discussion and as shown in Fig. 13, vinyl plastic of 20 per cent plasticizer content provides high impact strength at 130°F. and retains a high

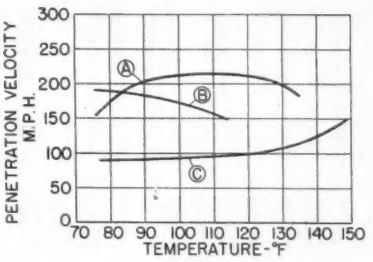
PENETRATION VELOCITY
M.P.H.
300
250
200
150
100
50
0
70 80 90 100 110 120 130 140 150
TEMPERATURE - °F
A TYPE (a) WINDSHIELD OF FIG. 3 WITH ¼ INCH VINYL THICKNESS (20 PERCENT PLASTICIZER)
B SAME AS A BUT WITH 30 PERCENT PLASTICIZER
C CELLULOSE ACETATE (TYPE (c), FIG. 2) ½ INCH THICKNESS

FIG. 13. Variation of penetration velocity with temperature of glass-vinyl and cellulose acetate windshields for 14-lb. carcass. Mounting angle same as in DC-3 airplane.

proportion of this strength at 75°F. It may be concluded that a 20 per cent plasticizer content represents about an optimum plasticizer content for a deicing-type windshield.

Because of the rapid decrease in impact strength of the vinyl plastic at low temperatures, it appears necessary under flight conditions with a warm air deicing-type windshield to circulate a limited amount of heated air under all conditions of low outside air temperature if adequate impact strength of the windshield is to be retained.

Optical Characteristics of Laminated Windshield Panels

A high degree of optical perfection of the windshield is generally desired in air carrier and other large aircraft. The most serious types of visual disturbances that may be present in flat double-pane windshields are:

(1) Distortion associated with local surface curvature or lack of surface parallelism.

(2) Reflections caused by the existence of multiple reflecting surfaces.

(3) Surface scratches where plastic panel surfaces are used.

No tests concerned with optical characteristics of windshields have been included in the present program. However, although it has been indicated that the visual characteristics of a double-pane windshield are inferior to a single-pane arrangement,[6] it is generally considered that the types of construction described in the present report, which are shown to be most suitable with regard to impact strength, can be produced within reasonable limits of optical distortion and other visual disturbances.

CONCLUSIONS

(1) The type of double-pane deicing windshield which provides maximum impact resistance against collision with birds in flight for minimum weight of

(*Continued on page 123*)

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Control Wheel Bearing A10 20
Control Column Chain and Sprocket 285 20
Throttle and Propeller Control A10 20
Tab Control Mechanism A10 20
Parking Brake Latch A10 20
Parking Brake Bearing A10 20
Brake System Reserve Tank U40 10
Propeller Governor Bearings 285 10
Propeller Hub A10 10
Brake Linkage A10 20
Landing Gear Mitre Gear Box 285 100
Landing Gear Universal Joints A10 20
Landing Gear Worm Gear Box 285 100
Landing Gear Link Tube Bearings A10 20
Landing Gear Hinge Bearings 285 20
Shock Strut HBF 100
Landing Gear Scissors 285 100
Landing Gear Wheel Bearings ALB 100
20 A10 Elevator Tab Drive Drum Bearings
20 A10 Rudder Hinge Bearings
10 A10 Elevator Tab Drive Screws and Arms
10 A10 Elevator Tab Hinge
20 A10 Elevator Hinges
100 HBF Tail Wheel Shock Strut
20 A10 Tail Wheel Attachment Points
100 285 Tail Wheel Swivel Bearings
100 285 Tail Wheel Bearings
20 A10 Tail Wheel Centering Spring Swivel
20 A10 Landing Flap Vacuum Cylinder Piston Rods
20 A10 Wing Landing Flap Torque Tube Bearings
20 A10 Wing Landing Flap Bearings
20 A10 Fuselage Landing Flap Bearings
100 A10 Aileron Hinge Bearings
20 A10 Landing Light Hinge Bearings
100 295 Landing Light Motor Drive Gears
KEY
FUEL AND OIL RECOMMENDATIONS
ENGINE MAKE Pratt & Whitney Wasp Jr. MODEL SB
PLANE MODEL 7W
FUEL GRADE Take Off 87 Normal 80
OIL GRADE Ground Temperature 70°F. to 20°F. 100 Above 70°F. 120 Below 20°F. 100
CAPACITIES
ENGINE OIL TANK — 28 qt.
FUEL TANKS
Main Tanks — 32 gal. (each tank)
Auxiliary Tanks — 16½ gal. (each tank)
Reserve Tank — 13 gal.
TIRES
MAIN LANDING GEAR Size 8.50-10 Inflation Pressure 26 lb.
TAIL WHEEL 10.00, 10.50 45 lb.
ESSO AVIATION LUBRICANTS
A10 = ESSO AVIATION INSTRUMENT OIL
285 = ESSO AVIATION GREASE H-285
HBF = ATLAS HYDRAULIC BRAKE FLUID
ALB = ESSO AVIATION GREASE ALB
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1 page from the Aircraft Lubrication Manual

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Aircraft Hydraulic Pumps and Related Accessories

JOHN A. LAUCK*

Pesco Products Company

Introduction

Use of hydraulic power for the operation of machinery is far from new. Many machine tool manufacturers have been utilizing this method of power application for a number of years.

Comparatively speaking, the aircraft industry has just recently adopted the use of the hydraulic system. The installation of retractable landing gear and wing flaps made it necessary for the aircraft manufacturers to provide a mechanical means of operation of this equipment. This could be accomplished either hydraulically or electrically. The hydraulic system has advantages over the electrical method because:

(1) Its use affects a considerable savings in weight.

(2) Its operation is faster.

(3) It requires less service attention.

The first airplane of any consequence to use hydraulic systems was the Douglas DC-3 transport, which, it is generally agreed, has given remarkable service for a number of years. The development of the hydraulic pump for the first transport airplane was not a particularly difficult engineering problem. The operating pressures were from 600 to 800 lbs. per sq.in., and the ambient air temperature was never below 20° below zero. Operational altitude never exceeded 15,000 ft. The oil reservoirs were of sufficient volume that the oil temperatures remained quite low. The first hydraulic pumps were the gear type in which close end clearances were required to obtain reasonable efficiency. There were a few pump failures during the winter, but, generally speaking, these fixed clearance pumps required little service.

Military Aircraft Problems

Analysis of the operation of military aircraft in combat areas in World War II provided the aircraft manufacturer with an entirely new series of problems, one of which was the operation of the hydraulic system. Pumps that had performed satisfactorily heretofore would not operate at altitudes above 25,000 ft., nor would they operate at temperatures below −20°F. or at temperatures above 150°F. The Army Air Forces were aware of these problems prior to World War II and had issued specifications requiring pump operation at extreme high and low temperatures, as well as at altitude. The service life of the pump was also taken into consideration in the new specifications that required that pump efficiency should not fall off more than 15 per cent during a 500-hour endurance test. Here again, the original fixed clearance-type pump was eliminated, since it would lose approximately 50 per cent of its efficiency during the 500-hour-life test run. Although the condition specified in the 500-hour-life-run requirements were more severe than those to which the pump would be subjected on an airplane, nevertheless, it was evident through life tests and laboratory tests that the fixed clearance-type pump was unsuitable for combat airplanes. The lack of a good hydraulic pump that would meet the requirements of combat airplane duty caused both the airplane manufacturer and the Army Air Forces to become severely critical of the use of the hydraulic system.

There were only two alternative courses of action open to the pump manufacturer at that time: one, to improve the fixed clearance gear pump; the other, to develop a piston-type pump that would meet the requirements. It was finally decided that development work on both types ought to be carried on simultaneously. The plunger pump design selected was patterned after the Waterbury and Janney patents. Most of the available engineering time was concentrated on the development of the plunger pump. The results were quite gratifying inasmuch as mechanical and volumetric efficiencies well above 90 per cent were obtained. It appeared for a time as if this pump were the answer to the A.A.F. requirement. There were, however, two factors in connection with the plunger pump design that were disheartening. The cost of manufacture was approximately three times that of the conventional gear pump, and the service life of the plunger pump was comparatively short.

Improving the Gear-Type Pump

The engineering group that had been assigned to the improvement of the gear-type pump had the idea about the same time of automatically controlling the gear end clearance by hydraulically loading the floating bushings. The gear end clearance could thereby be maintained at a minimum. Tests of this new pump showed volumetric efficiencies above 90 per cent and torque efficiencies above 70 per cent. Furthermore, these efficiencies improved with service life. The tests also proved that the pump would operate satisfactorily over a temperature range of −85° to +160°F. The relative simplicity of its construction as compared to the plunger-type pump permitted a substantially lower cost of manufacture. After a series of rigid tests, the pump was finally approved as an A.A.F. type. The success of this new gear-type pump did not alter the engineering program on plunger pumps, and considerable effort was extended in attempting to develop a suitable inexpensive plunger pump of a fixed and variable displacement type that would meet the new requirements.

Simplification of Hydraulic Systems

There is a definite trend toward simplification of hydraulic systems, and one of the problems confronting the hydraulic manufacturer is the extent to which this simplification may be carried. The present hydraulic system is quite complicated and generally consists of the following: (1) hydraulic pump (fixed displacement), (2) hydraulic check valve, (3) hydraulic pressure regulator, (4) hydraulic accumulator, (5) hydraulic relief valve, (6) hydraulic selector valves, (7) hydraulic cylinders, (8) hydraulic supply tank or reservoirs, and (9) emergency hand pump.

In this particular system the hydraulic accumulator has been one of the

Presented at the National Light Aircraft Meeting, I.A.S., Detroit, April 27–28, 1944.

* Chief Engineer, Pesco Products Company Division of Borg-Warner Corporation.

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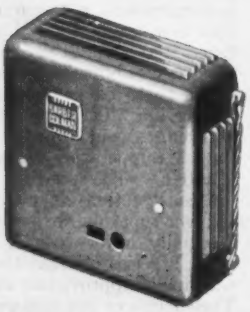

Type CYLD SINGLE ELEMENT CABIN THERMOSTAT. Weight, 7 oz. Dimensions, 3-1/4" x 3-1/2" x 1-5/16".

Type DYLD DUPLEX CABIN THERMOSTAT. Weight, 17 oz. Dimensions, 6" x 3-1/2" x 1-5/16".

Type FYLC CONTROL MOTOR. Maximum torque, 50 lb. in. Approximate weight, 2-1/4 lbs. Available with or without right-angle drive.

Type BYLC CONTROL MOTOR. Maximum torque, 500 lb. in. Weight, 3 lbs. 4 oz. Available with or without right-angle drive.

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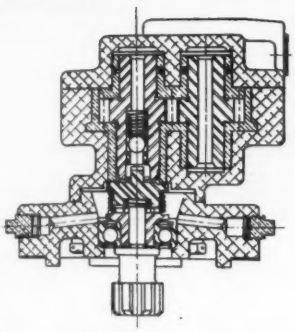


FIG. 1. Fixed clearance gear pump.

chief troubles. The purpose of the accumulator, originally, was to store enough oil under pressure to operate the landing gear and the flap in case of pump failure. The accumulators necessarily had to be large in order to store a sufficient quantity of oil and were consequently vulnerable to gunfire. Later, the accumulators were used to dampen out line surges and to increase the speed of operation of actuating cylinders. These cylinders, too, are the object of criticism, since they are heavy, bulky, and offer a considerable service problem.

The Variable Displacement Pump

One of the proposed simplified hydraulic systems under consideration and test utilizes the variable displacement pump. This hydraulic system generally consists of the following: (1) variable displacement plunger pump, (2) check valve, (3) relief valves, (4) selector valves, (5) hydraulic cylinders, (6) reservoirs, and (7) emergency pump.

It will be noted that the hydraulic accumulator and the pressure regulator valve are eliminated in this system, thereby affecting a saving in weight and a reduction in cost of installation through elimination of complicated plumbing.

Open-Center System

A second proposed system, called the "Open-Center System," consists of: (1) fixed displacement hydraulic pump, (2) check valve, (3) open-center selector valve with pressure relief, (4) hydraulic cylinders, (5) reservoir, and (6) emergency hand pump.

This system employs a fixed displacement hydraulic pump with a combination open-center selector valve and a pressure relief valve. The open-center selector valve returns to the neutral position after a selected operation has been completed. In this position it permits the full flow of the hydraulic pump to be returned to the oil reservoir with practically no pressure except that due to line and valve loss. This is probably the least expensive of all of the proposed systems.

Power Package System

A third proposed system is the hydraulic power package system, which is suggested for use on the large trans-

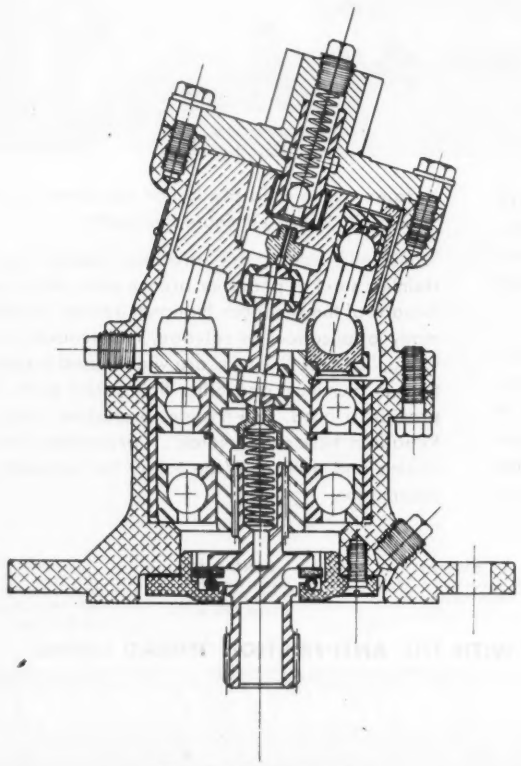


FIG. 2. Plunger pump.

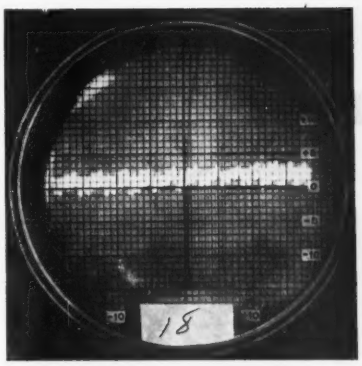


FIG. 3. Gear pump.

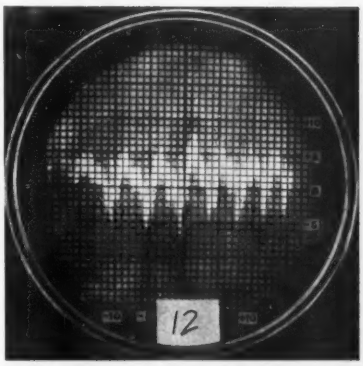


FIG. 4. Plunger pump—modified.

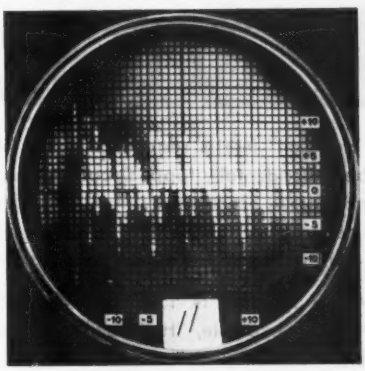


FIG. 5. Plunger pump.

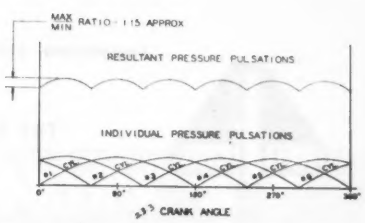
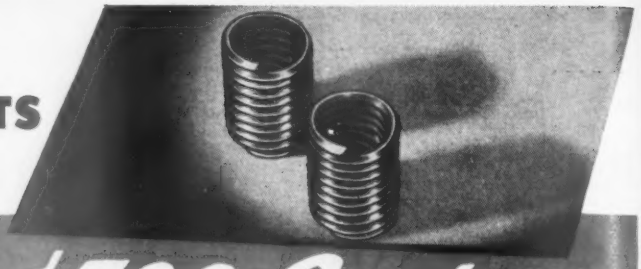


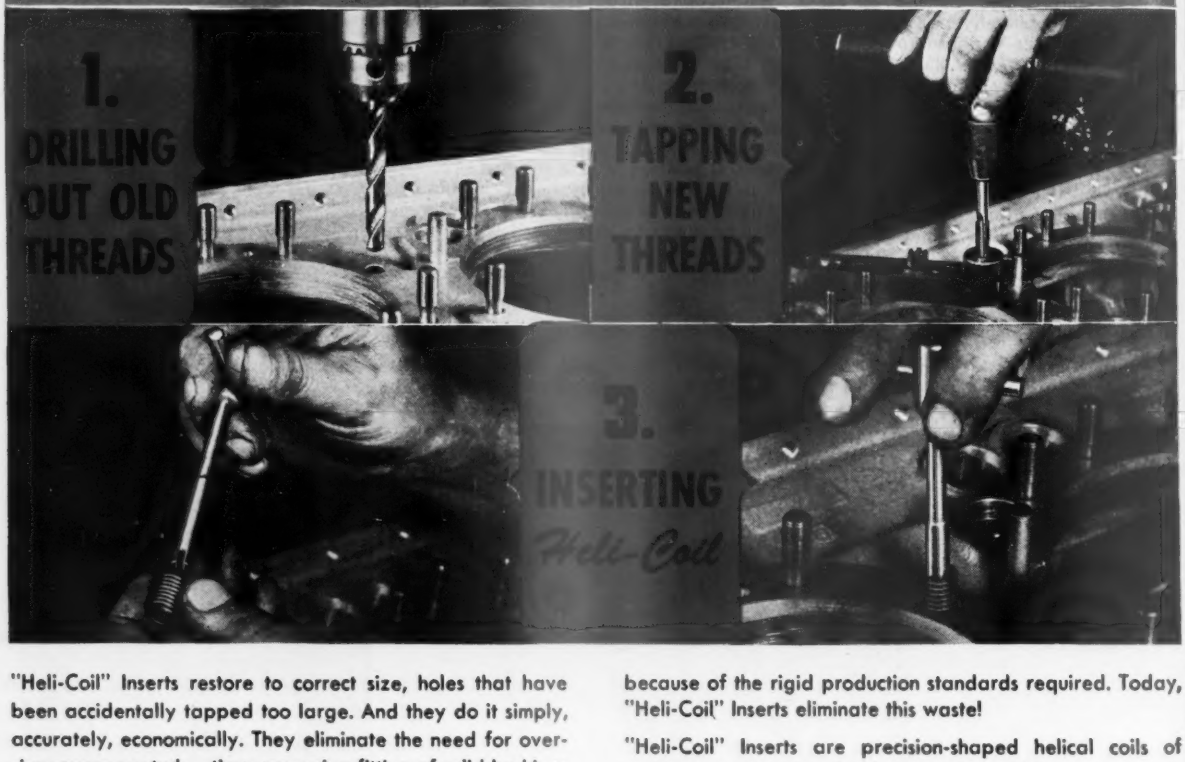
FIG. 6. Pressure pulsations. Six-cylinder plunger-type hydraulic pump.

HOW *Heli-Coil* INSERTS



Salvage a $500 Casting

IN THREE SIMPLE STEPS!



"Heli-Coil" Inserts restore to correct size, holes that have been accidentally tapped too large. And they do it simply, accurately, economically. They eliminate the need for oversize screws or studs—time-consuming fitting of solid bushings—or the complete scrapping of the casting!

At the Syracuse, N. Y., plant of Aircooled Motors Corporation, for example, "Heli-Coil" Inserts are used to salvage aluminum alloy helicopter crankcase castings valued at $500—as well as in intermediate and timing gear case magnesium castings. Formerly, even when a casting had only one hole tapped oversize, it was necessary to scrap it because of the rigid production standards required. Today, "Heli-Coil" Inserts eliminate this waste!

"Heli-Coil" Inserts are precision-shaped helical coils of stainless steel or phosphor bronze wire, which engage screw threads of the American National System. In addition to their many applications in salvage, maintenance and field servicing, "Heli-Coil" Inserts are widely used in original installations in aluminum and other light metal parts. These inserts provide a hard, anti-friction, protective lining for tapped threads in these softer metals . . . preventing thread stripping, seizing and galling. Write today for complete engineering information.

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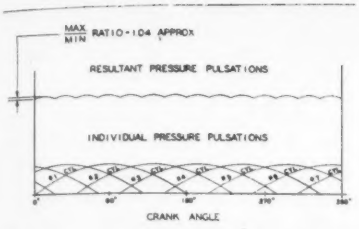


FIG. 7. Pressure pulsations. Seven-cylinder plunger-type hydraulic pump.

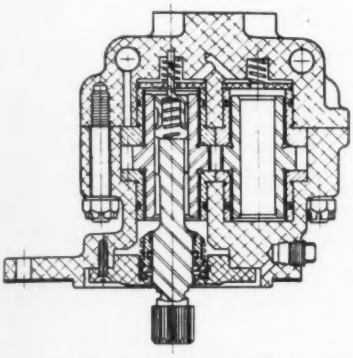


FIG. 8. Pressure-loaded bushing type.

port and cargo airplanes. This system consists of: (1) package hydraulic unit, (2) hydraulic cylinder, and (3) hydraulic hand pump.

The package hydraulic unit consists of a reservoir, an electrically driven pump, a pressure relief valve, and a pressure switch.

The high pressure required to operate cylinders on large airplanes has been one of the principal causes of failures. The high pressure comes about particularly in cold weather operation through extreme line pressure loss between the engine-driven pump and the actuating cylinder because of the distance between these two accessories. The new hydraulic package system eliminates this difficulty, since the package unit may be installed close to the hydraulic cylinders, which obviously eliminates the long line for transmission of hydraulic power. Most of these systems will be designed for operation at 3,000 lbs. per sq.in. pressure and will offer these advantages: (1) weight saving, (2) simple installation, (3) simple service problems, (4) increased service life for the hydraulic system, and (5) cheaper installation.

It is not feasible to attempt to predict the course of the future trend, but it can faithfully be said that one of the three systems outlined will be used in the future hydraulic system. The service life characteristics of each of these systems will certainly be the determining factor in its ultimate use.

THE FIXED CLEARANCE HYDRAULIC PUMP

Fig. 1 illustrates the original fixed clearance hydraulic pump that was the principal source of hydraulic power in aircraft until the advent of the pressure-loaded bushing-type pump. This pump consisted of two gears, one of which was driven by the other running in a bronze-lined aluminum housing. The gears were driven by a universal drive block that also served as a drive seal. The gears were accurately fitted within the body, the permissible end clearance being 0.0005 to 0.00007 on either side of the gear. A clearance of 0.001 to 0.002 was maintained between the tips of the gears and the body in order to minimize slip around the gears. As the gear and bushing faces wore, the pump efficiency dropped off rapidly, and the units required reworking after a period of 1,000 to 2,000 hours of operation.

The seal arrangement was satisfactory when the pump was new, but, as wear accumulated on the bearing, maintenance of a satisfactory seal became a serious problem. Increased journal clearances permitted an increased escape of oil through the drive gear bearing to the seal block. As the flow increased through the bearing, the pressure against the seal increased because of the spring load on the check valve, thus causing the seal to separate from the seat. This allowed an excessive seal leakage, which could be corrected only by a complete pump overhaul. Performance of this unit depended to a considerable extent upon the operating temperature. When cold, the body would contract more than the gears, causing seizure of the pump at extremely low temperatures, and at increased temperatures the body would expand more than the gears, thereby causing considerable reduction in volumetric efficiency.

SEVEN-CYLINDER PLUNGER PUMP

Fig. 2 shows the internal construction of a seven-cylinder plunger pump. It is readily apparent that the construction of this unit is considerably more complicated than is the gear-type pump. In one respect the two types of construction have a similar characteristic in that wear, particularly on the cylinders of the plunger pump causes a reduction in volumetric efficiency. Here again, a complete pump overhaul is required to provide normal capacity. The lead-bronze cylinder was actuated by the drive plate through a universal drive. The seven pistons and rod were connected to a drive plate by a ball joint. With this arrangement there is little angular motion to the connecting rod. It is extremely important in this design pump that the hydraulic fluid be thoroughly filtered to prevent scoring of the cylinder block against the cover.

PUMP PRESSURE CYCLES

Figs. 3, 4, and 5 are charts showing the pressure cycles inherent in a plunger pump and in a gear pump. These pul-

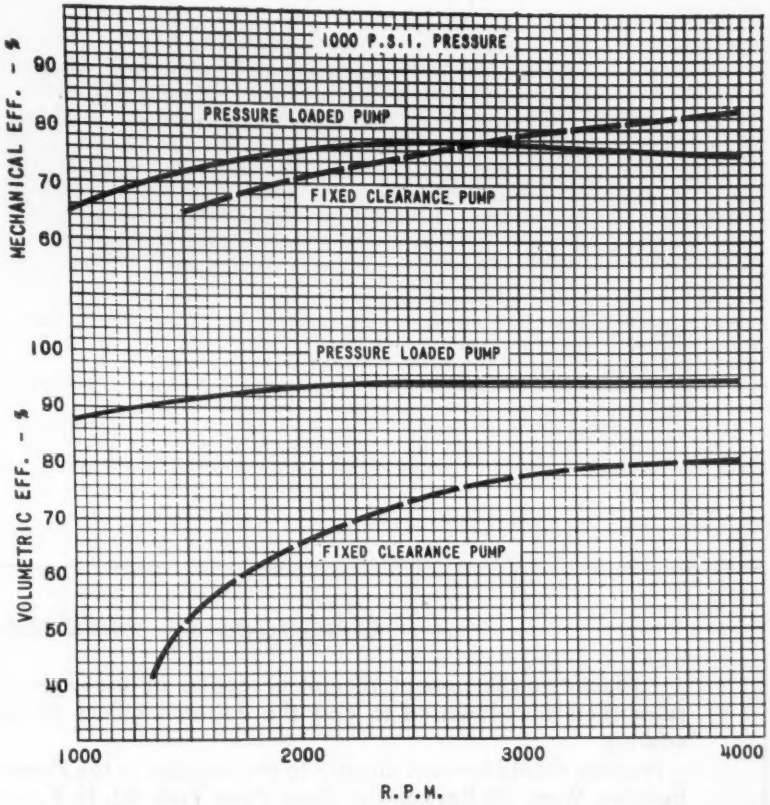


FIG. 9. Performance comparison curve between fixed-clearance- and pressure-loaded-type pumps.

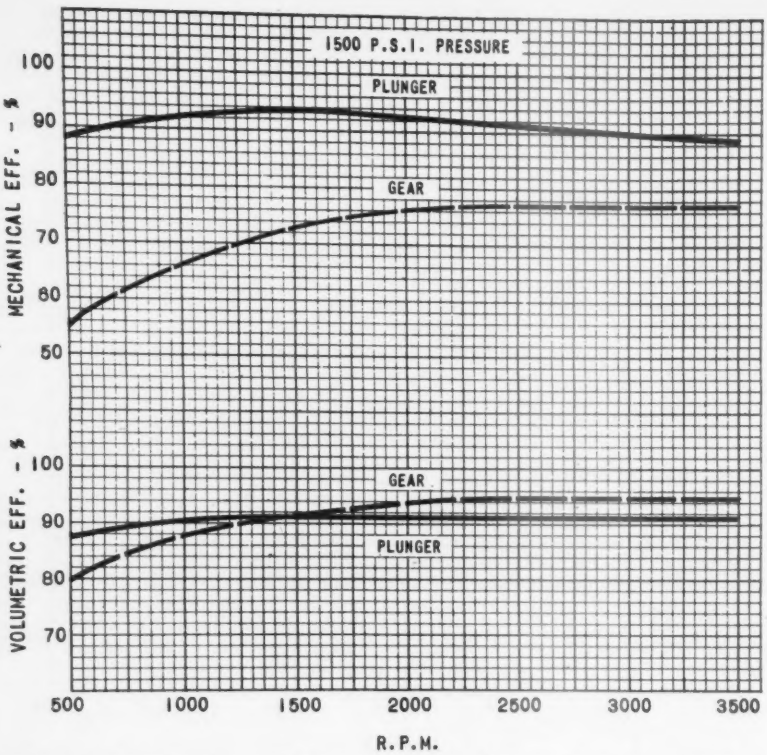


FIG. 10. Performance comparison curve between plunger- and gear-type pumps.

sations were charted by use of an oscillograph with the pressure pickup unit placed approximately 6 in. from the discharge port.

Figs. 6 and 7 illustrate the calculated pressure pulsation cycles of six- and seven-cylinder design of pumps. These pulsations are considerably augmented in actual operation, as was shown on Fig. 5. In this particular design of pump the cylinder pressure is raised from atmospheric pressure to working pressure instantaneously, which accounts for the extremely high pulsations. This is not true of all plunger pumps, but in most instances there is an inherent pulsation that is quite noticeable in operation. In the gear pump the pressure increases by increments in the gear-tooth cavity as the gear rotates.

Thus, as the teeth approach the discharge port, the pressure within the teeth has reached a pressure nearly

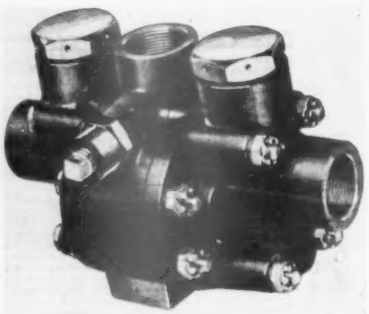


FIG. 11. Equalizing flow divider.

equal to the operating pressure. This accounts for the low pulsations of the gear-type pump.

Fig. 4 illustrates the improvement that can be made in the pulsations of the plunger-type pump by raising the cylinder pressure [illegible]ly. This is accomplished by bl[illegible]g a small amount of oil from the out[illegible]ort to the cylinder prior to the discharge cycle, thereby slowly raising the cylinder pressure before the full pressure can reach the cylinder. At a working pressure of 1000 lbs. per sq.in. at a fixed speed of 3,000 r.p.m., the gear pump has a maximum pulsating pressure of approximately 21 lbs. per sq.in. Under the same conditions the plunger pump, not modified, has a pulsating pressure of approximately 122 lbs., which, by modifying the outlet port design, can be reduced to approximately 72 lbs. per sq.in.

THE A.A.F. PRESSURE-LOADED GEAR PUMP

Fig. 8 shows a section through the A.A.F.-type pressure-loaded gear pump. In this design the discharge pressure is communicated to the back side of the cover bushing. The gear or face side of the bushing is undercut close to the journal and is relieved to the inlet side of the pump in order to obtain a slight differential loading of the bushings toward the gears. The differential load is low and does not noticeably reduce the torque efficiency of the pump. The gain in volumetric efficiency over that of the fixed clearance-type pump is substantial, however, as may be observed in Fig. 9. An outstanding advantage of this design is that the efficiency improves with service because of the lapping effect of the bushings on the gear faces. The spring load on the cover bushings serves only to hold the bushings against the gears during the priming operation. It will be noted that a positive type of drive seal is used which is both spring- and pressure-loaded to maintain a perfect seal at all times. Fig. 10 shows the performance comparison between a plunger-type pump and a pressure-loaded type of gear pump.

HYDRAULIC FLOW EQUALIZER

Fig. 11 illustrates a hydraulic flow equalizer that is used in aircraft installation to synchronize the movement of the wing flaps. The purpose of the flow equalizer is to divide a line of fluid into two or more equal flows irrespective of the individual line pressures. The unit consists of two hydraulic synchronized motors driven by a common inlet with equal outlet pressures regulated by means of balancing valves.

Changes of Address

To facilitate the prompt receipt of copies of the *Journal* and *Review*, members and subscribers are requested to give the editorial offices 30 days' notice of any change of address.

Notices should be sent directly to the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N.Y.

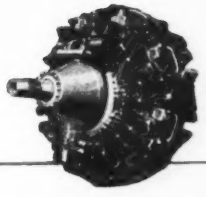
Greater Pay-Loads with Fill-in Freight

Greater still with Cyclones

Hotel rooms vacant overnight, empty seats in the orchestra, or a plane in flight with unfilled passenger or cargo space, all these represent revenue lost forever. The same holds true of any space sold by the hour or mile: anything less than capacity is a sales opportunity permanently lost.

In the air transport field, fill-in freight to build up full payloads is one way of getting capacity use on every flight. A constant stockpile of such freight, moving at preferential rates, fills the balance of weight and space capacity after loading passengers, mail and air express. Such rates gradually attract more and more commodities to air travel. The net results: full payloads and increased revenue on every flight.

To such flight operations, Wright Cyclones contribute an extra bonus in payload, due to their lower weight ratio and low fuel consumption. In addition, their ease of maintenance adds to the reasons why these dependable sources of power pay their way.



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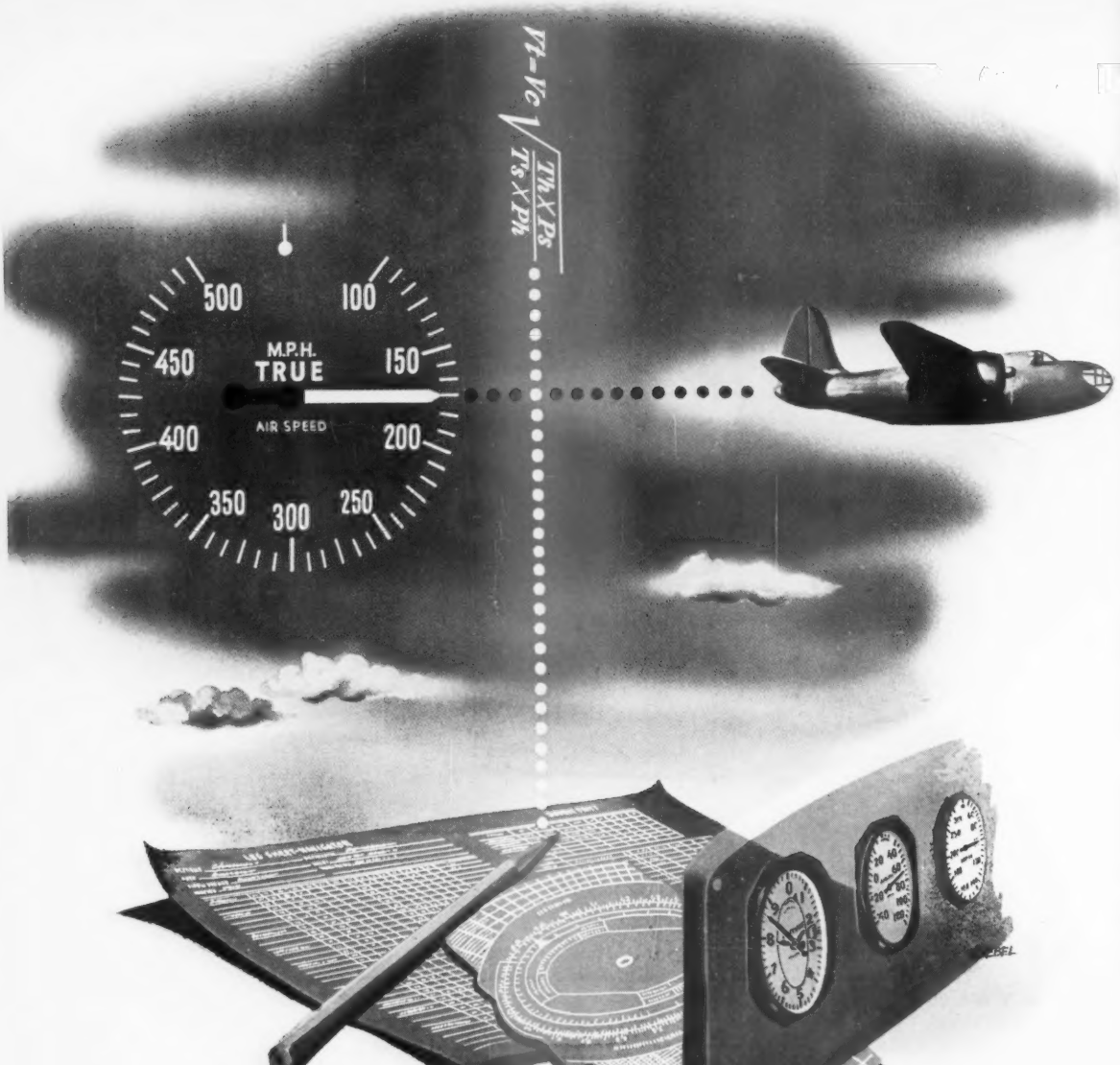

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Institute News

Presentation of the Robert J. Collier Trophy for 1943 and the Wright Brothers Lecture for 1944

The Robert J. Collier Trophy

On Sunday, December 17, 1944, the 41st Anniversary of the first airplane flights of the Wright Brothers at Kittyhawk, N.C., the National Aeronautic Association presented the Robert J. Collier Trophy for 1943 to Capt. Luis de Florez, U.S.N.R., Fellow of the Institute. Certificates of award were also presented to former recipients of the Robert J. Collier Trophy. The presentations preceded the Eighth Wright Brothers Lecture.

The ceremonies of the presentation and the lecture were held in the Auditorium of the Chamber of Commerce of the United States of America, Washington, D.C., commencing at 3:00 p.m. Seven hundred members and guests of the National Aeronautic Association and the Institute of the Aeronautical Sciences attended the joint meeting.

William R. Enyart, President of the National Aeronautic Association, opened the meeting and welcomed the recipients and guests. He expressed his appreciation to the Institute for extending to the National Aeronautic Association the invitation to hold a joint meeting. In paying tribute to the achievements of the Wright Brothers, Mr. Enyart said in part:

"Our commemoration of this greatly significant date in human history shall be simple, in keeping with the unheralded origins of this science. But let none gainsay the significance of that very simplicity. No elaboration of ceremony could properly honor the self-sacrificing devotion, the painstaking care, the great genius of mind exhibited by the brothers Wilbur and Orville Wright."

Following Mr. Enyart's opening remarks, Grover C. Loening, Chairman of the Robert J. Collier Trophy Committee, gave a brief summary of the establishment of the Trophy in 1911, emphasizing that when first presented this Trophy was designated by Mr. Collier as the "Aero Club of America Trophy" to be awarded for "the greatest achievement in aviation in America, the value of which has been demonstrated by actual use during the preceding year."

Mr. Loening introduced the Hon. Henry A. Wallace, Vice-President of the United States, who made the presentation of the Trophy to Capt. Luis de Florez, Director, Special Devices Section, Bureau of Aeronautics, Navy Department, "for his contribution to the safe and rapid training of combat pilots and crews." In his presentation address, Vice-President Wallace said in part:

"We should look at the past only as a guide of how we can better use the airplane for the greater benefit of man. That this gift has become a weapon in war was not the desire or wish of its inventors. It is not our desire today. We have been forced regretfully to that utilization by necessity. Our job now is to make such employment only a passing phase in a long and glorious history. Our job is to see to it that the airplane becomes as powerful a force in peace as it has been in war."

In accepting the award, Captain de Florez said in part:

"Our mission has been clear—to teach the use of equipment resulting from the greatest period of technologic development in history. To teach quickly—for in war, time is always short. To teach the use of complex, powerful, deadly machines to boys barely out of school. Boys short on experience, but long on courage, devotion, and eagerness to serve.

"To teach so effectively that these lads could use this equipment to achieve victory and survival.

"In following new concepts, in exploring new fields, it is never possible to predict with certainty the outcome of our plans or experiments.

"We need faith in our purpose, to gain the courage to go on—relying on the knowledge we acquire on the way.

"We need faith to overcome disappointment, doubt, and, perhaps most of all, the drag of those who condemn risk per se.

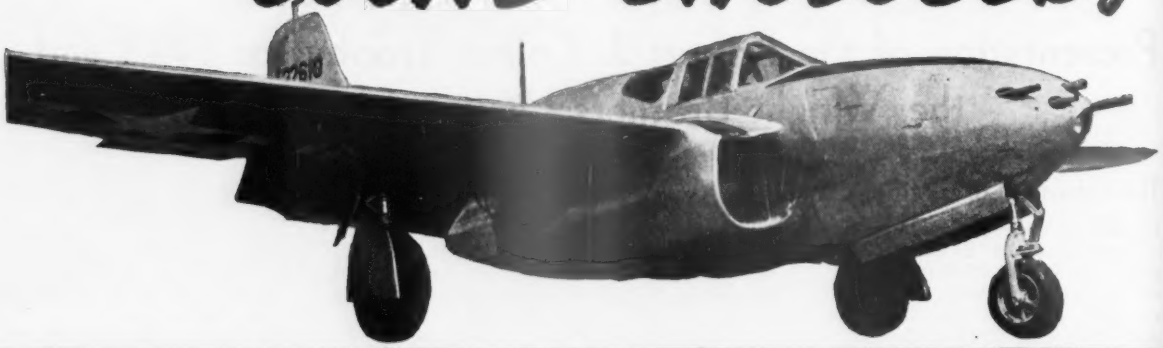
"For we must ever bear in mind that important progress comes only when objectives are chosen for their promise of advancement rather than for ease or certainty of accomplishment.

"Forty-one years ago, two great pioneers, whose achievement we commemorate today, hitched our wagon to the stars. May God grant us the wisdom to teach our youth to ride it to victory and survival that, one day, they may serve their country in peace as they have in war—willingly and effectively."

Following the presentation of the Trophy for 1943, past recipients and representatives of past recipients of the Trophy were presented with certificates

The Hon. Henry A. Wallace congratulates Capt. Luis de Florez on receiving the Robert J. Collier Trophy for 1943.

JET PROPELLED! "LUCITE" ENCLOSED!



TOP AND SIDE OF COCKPIT ON

BELL AIRCRAFT'S P-59A AIRACOMET

Protected by Du Pont "Lucite" Methyl Methacrylate Resin Sheets

CHIEF distinction of this Army Air Force jet-propelled plane is the absence of a propeller—which allows it to be built low to the ground. Weighing more than five tons, the P-59A Airacomet is practically vibrationless and has a speed of over 400 miles per hour—driven by the powerful thrust of the gases leaving the nozzles of the jet engines.

Transparent enclosures of "Lucite" methyl methacrylate resin are installed in the top and side sections of the cockpit canopy. In addition, a dome-shaped lens of "Lucite" protects the landing light located in the tip of the nose.

The crystal-clear *transparency*, light weight, excellent tensile properties, ease of forming, finishing and mounting make it suitable for a wide variety of aircraft applications.

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These are top and side sections of cockpit enclosure. Worker is polishing dome-shaped "Lucite" landing light lens.

DU PONT

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BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

of award. The following gives the list of recipients from 1911 through 1942: 1911 and 1912—Glenn H. Curtiss; 1913—Orville Wright; 1914—Elmer A. Sperry; 1915—W. Starling Burgess; 1916—Elmer A. Sperry and Lawrence B. Sperry; (the Trophy was not awarded from 1917 to 1920 because of the war); 1921—Grover C. Loening; 1922—personnel of the U.S. Air Mail Service; 1923—Pilots and other personnel of the U.S. Air Mail Service; 1924—U.S. Army Air Service; 1925—S. Albert Reed; 1926—Major E. L. Hoffman; 1927—Charles L. Lawrance; 1928—Aeronautics Branch, Department of Commerce; 1929—National Advisory Committee for Aeronautics; 1930—Harold F. Pitcairn and his associates; 1931—Packard Motor Car Company; 1932—Glenn L. Martin; 1933—Hamilton Standard Propeller Company, with particular credit to Frank Walker Caldwell; 1934—Capt. Albert F. Hegenberger, U.S. Army Air Corps; 1935—Donald W. Douglas and the technical and production personnel of the Douglas Aircraft Company, Inc.; 1936—Pan American Airways; 1937—the U.S. Army Air Corps; 1938—Howard Hughes and Associates; 1939—the Air Lines of the United States, with special recognition to Drs. Walter M. Boothby and W. Randolph Lovelace, II, and Capt. Harry G. Armstrong; 1940—Dr. Sanford A. Moss and the Army Air Corps; 1941—Army Air Forces and the Air Lines of the United States; 1942—Gen. H. H. Arnold.

The Eighth Wright Brothers Lecture

Edward P. Warner, Vice-Chairman of the Civil Aeronautics Board, presided as Chairman for the presentation of the Wright Brothers Lecture for 1944. This Lecture is presented each year to commemorate the first flights of the Wright Brothers, December 17, 1903. Following the inaugural Lecture in 1937, it was endowed by the Vernon Lynch Fund, established by the late Edward C. Lynch in memory of his brother.

In a brief introduction, Mr. Warner recalled some of the work of early pioneers and paid tribute to the Wright Brothers. He then introduced John Stack, Chief of the Compressibility Research Division of the Langley Memorial Aeronautical Laboratory, National Advisory Committee for Aeronautics, who spoke on "Compressible Flows in Aeronautics."

The first part of the Lecture, following the introductory remarks, consisted of a historical sketch and included a statement of the problems first encountered in aeronautics because of compressibility.

In the second part of the Lecture, flows above the critical speed were discussed, and an explanation was made of the theoretic aspects of compressible flows. The significance of shock was also discussed.

The concluding part of the Lecture consisted of an exposition of how compressible flows affect modern aerodynamics and included some significant developments as applied to the design of high-speed aircraft. Mr. Stack also showed high-speed motion pictures of subsonic and transsonic flows around an airfoil.

John Stack.

Prepared discussion of the lecture was given by Neil P. Bailey, Head, Department of Mechanical Engineering, Rensselaer Polytechnic Institute; Dr. Hugh L. Dryden, Chief, Mechanics and Sound Division, National Bureau of Standards; Dr. Norton B. Moore of the Southern California Cooperative Wind Tunnel; and L. E. Root, Chief Aerodynamicist, Douglas Aircraft Company, Inc. The Institute was honored by the attendance of its first Honorary Fellow, Orville Wright.

The complete lecture and discussions will be published in the April issue of the JOURNAL OF THE AERONAUTICAL SCIENCES.

Heinmuller Collection of Flight Covers Presented to Institute

At a meeting of the Collectors Club on November 15, John P. V. Heinmuller, Chief Timer of the National Aeronautic Association and President of Longines-Wittnauer Watch Company, exhibited his historical collection of flight covers and related some of his experiences with famous flights and fliers.

At the close of the meeting, Lester D. Gardner, President of the Aeronautical Archives of the Institute, announced that Mr. Heinmuller had presented to the Archives his great collection of flight covers. It represents 30 years of specialized collecting and comprises over 5,000 pieces.

The collection includes relics of most of the early pioneer flights of all countries, ocean crossings, first flights on leading air routes of the world, and special volumes from Canada, Philippine Islands, and other countries.

In accepting the gift Mr. Gardner said: "The Aeronautical Archives, with its great collections of aeronautical prints, medals, models, and other memorabilia, will now become one of the great aeronautical philatelic centers of the world. The United States has taken an important part in air-mail development ever since Dr. John Jeffries of Boston carried a letter from William Franklin, dated December 16, 1784, over the English Channel and delivered it to W. T. Franklin. From then, through the balloon period and the great development of air lines in this country, collectors have been saving covers with special cachets on them. The Archives hopes that by making

War Cancellation of Annual Meeting and Honors Night Dinner

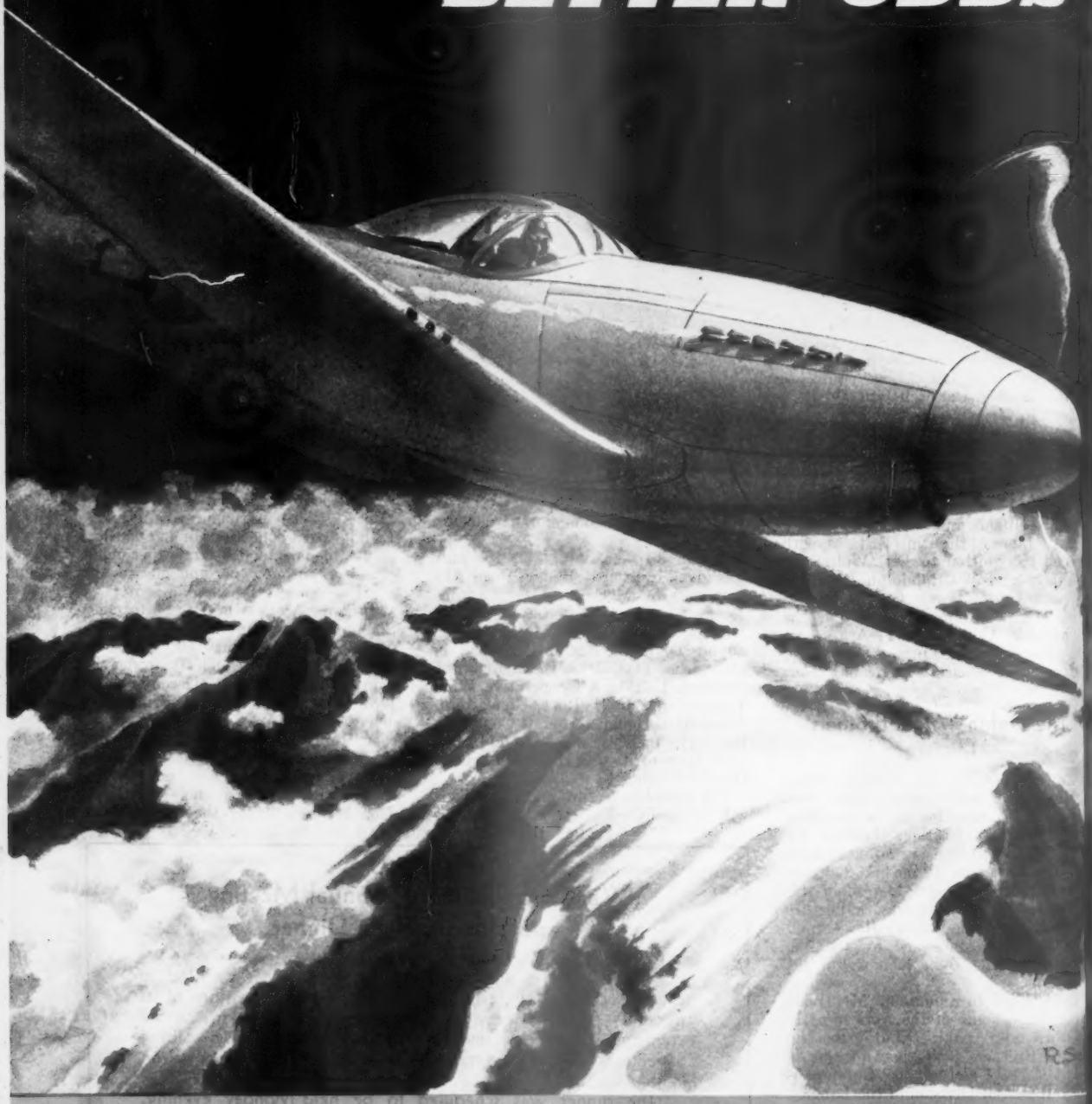
The Institute of the Aeronautical Sciences has decided to cancel its Honors Night Dinner and the Technical Sessions of its Thirteenth Annual Meeting to cooperate to the greatest possible extent with the recent Government appeal to refrain from holding conventions and meetings requiring the use of transportation facilities.

The dinner was scheduled to be held Monday evening, January 29, in the Grand Ballroom of the Hotel Waldorf-Astoria. The Technical Sessions were scheduled to be held at Columbia University for three days beginning January 30.

The Annual Business Meeting of members of the Institute will be held on Wednesday, January 31, as required by the Laws of the State of New York.

The 45 technical aeronautical papers which were scheduled for presentation at the Technical Sessions will be immediately considered by the Editorial Board of the Institute for early publication in the *Journal of the Aeronautical Sciences* and the *Aeronautical Engineering Review*, official publications of the Institute. In this way, the important scientific information contained in these papers will be disseminated to the aeronautical industry and profession.

BETTER "ODDS"



THREE OF MORE THAN THIRTY DUMORE AEROMOTORS

Dumore Type A2X explosion proof motor designed for anti-icer pumps, de-icer distributor valves, pumps and blowers.

Dumore Type E1Y2PBSR motors are used to operate cowl flaps and oil cooler flaps to prevent excessive temperatures of oil and main engines.

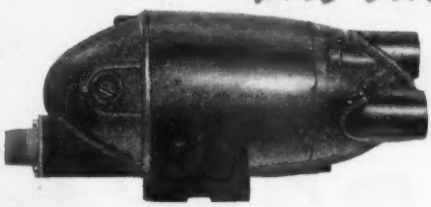
Dumore Type E1Y2PB motor, actuating oil cooler flaps and intercooler flaps. Prevents excessive temperatures in oil and supercharged air.

FOR OUR FIGHTERS!

Licking the ice menace gives our fighters the advantage of greater safety, and the ability to carry on the fight in foul weather as in fair. Ice on wing and tail surfaces can be removed, as it forms, by flexible ice boots or heated surfaces. Ice on the propeller is another matter. But this threat too, has been largely eliminated by the Adel anti-icer unit. This device applies a measured flow of anti-icing fluid to the prop blades. At the turn of a dial the pilot governs the flow from 1.25 gallon per hour to 30. Power for this pump comes from a specially engineered Dumore motor, built into the unit shown below.

COMBATTING the ice menace is one of more than thirty highly important functions assigned to Dumore Aeromotors on today's fighting aircraft. Like the planes they serve, these motors are designed and built to withstand conditions many times more severe than normal. Windings of the highest grade insulated wire are dipped and baked for insulation, and are then "pre-expanded" to eliminate "breathing." Commutator leads are swaged and soldered into the bars. Armatures are balanced statically and dynamically. Shielded ball bearings and bronze-graphite bearings, impregnated with special oil to provide adequate lubrication, insure perfect performance at wide extremes of temperature. Special brushes assure proper commutation at high levels and low air-pressures. Finally, Dumore "design modifications" integrate the elements of the drive mechanism with the motor itself, assuring sustained durability. Read the complete, interesting story of Dumore Aeromotors in our motor catalog. Ask for a copy today! Write the Dumore Company, Motor Division, Dept. MA10, Racine, Wis.

The Anti-Icer Unit



The Adel anti-icer unit combines a precision metering pump and a Dumore in-built motor. The unit is provided with rheostat control and operates much of the time at reduced speeds for low pump output. An essential requirement is extreme stability of speed, at low speeds. A definite maximum current drain at maximum pump output is established, which must nor be exceeded. With such details in mind, it is noteworthy that Dumore motor parts were selected to power this unit.

FOR *Extra* POWER HOURS

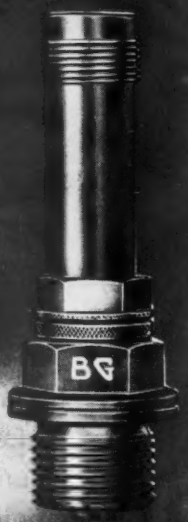
DUMORE

HEADQUARTERS FOR FRACTIONAL HORSEPOWER MOTORS

FOR AIRCRAFT ENGINES — AN AIRCRAFT SPARK PLUG

Out of Quality . . .

CHARACTER



The uncompromising quality of BG Spark Plugs, the experience which has gone into their design and the vigilance with which they are manufactured endow them with the characteristics of *reliability* . . . economy of operation . . . long, efficient life. Because they *can* be relied upon for *regularly* faithful performance of duty, BG Spark Plugs have become standard on major airlines.

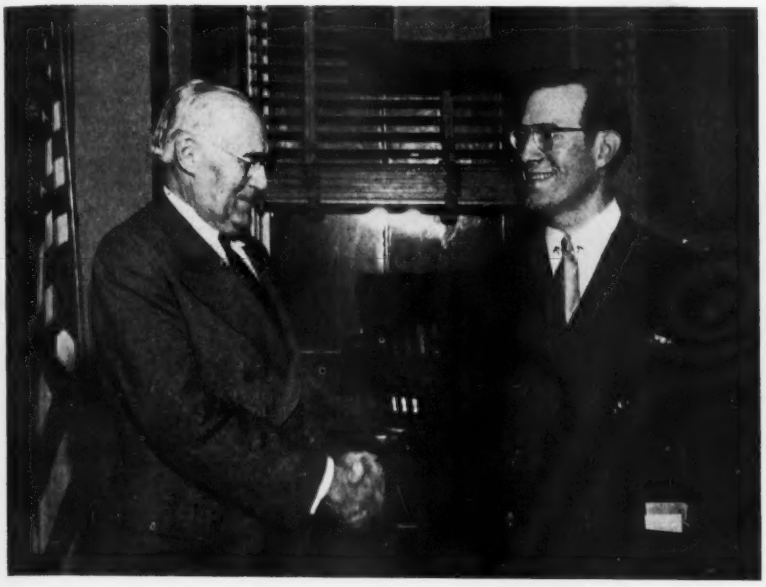
BG

THE BG CORPORATION

136 WEST 52ND STREET, NEW YORK, 19, N. Y.

Manufacturers of both mica-insulated and ceramic-insulated aviation spark plugs.

Contractors to the United States Army, Navy and Coast Guard and Aircraft Engine Builders



Lester D. Gardner (*left*) thanks John P. V. Heinmuller for his generous gifts to the Archives.

this rare collection available to the public that it may render a service to those who are interested in this phase of aeronautical history."

Mr. Heinmuller is the author of *Man's Fight to Fly*, which was published this year by Funk and Wagnalls. He has timed for the National Aeronautic Association nearly every world's record flight starting from New York, including the flights of Lindberg, Chamberlin, de Pinedo, Byrd, Amelia Earhart, Wiley Post, Hughes, etc. He has been a noted collector of rare air-mail covers and has received many awards at exhibitions. He came to New York from Switzerland in 1912 and has been successful in many developments of watches and aeronautical instruments.

The collection includes covers carried on pioneer U.S. flights, historical flights, C.A.M. and F.A.M. flights, international and early pioneer flights of various countries that have contributed to aviation, zeppelin flights, and transatlantic flights.

Mr. Heinmuller has also contributed $500 to cover the cost of an exhibition cabinet for this collection.

The Council of the Institute, in accepting Mr. Heinmuller's generous gifts, adopted the following resolution:

Resolved that the generous offer of Mr. John P. V. Heinmuller to present a collection of air-mail covers with a suitable case be accepted and that the Council express for the members of the Institute their great appreciation for his generosity in enlarging the scope of the collections of the Aeronautical Archives.

Gifts to the Aeronautical Archives

A book of clippings of A. Leo Stevens, who was active in aeronautics for more than 50 years until his death early in 1944, was received from Mrs. A. Leo Stevens. The book covers the period 1900 to 1938. A propeller-blade stub from a German Messerschmitt 109 G fighter plane that was shot down in the Mediterranean area was given by the Propeller Division of the Curtiss-Wright Corporation through the courtesy of J. D. Waugh. A china plate showing Air Corps and Paratrooper Units 1940 was received from the Abercrombie & Fitch Company.

Capt. G. P. Olley, of Liverpool, England, sent twelve insignia of Olley Air Service, Ltd., Railway Air Services, Isle of Man Air Services, and Great Western & Southern Air Lines. A Civil Air Patrol Search and Rescue Emblem was received from Major Kendall K. Hoyt. Paul Zimmerman gave a button of the Central Aircraft Corporation of China and a lapel pin of the American Aeronautical Corporation.

The American Society of Mechanical Engineers, through the courtesy of Ernest Hartford, gave a silver "Spirit of St. Louis" medal. The Ball & Roller Bearing Information Center gave its *Anti-Friction Bearing Maintenance Manual* and photographs through the courtesy of Daniel T. O'Brien.

Ninety-eight books and 2,600 issues of aeronautical magazines were received by exchange from the Library of Congress. This collection included *Curiosités Aréostatiques, Catalogue de la Collection Tissandier*, Paris, 1886; *L'Art de Voyager dans Les Airs, ou les Balloons*, Paris, 1784; *Le Vol des Oiseaux*, by E. J. Marey, Paris, 1890; *Études sur l'Aérostation*, by M. E. Marey-Monge, Paris, 1847; *Die Luftschiffahrt*, by A. Hildebrandt, Munich, 1907; *Die Brüder Wright*, by A. Hildebrandt, Berlin, 1909; and *L'Empire de l'Air*, by L. P. Mouillard, Paris, 1881.

Four *Reports & Memoranda* of the British Aeronautical Research Committee were sent by G. Geoffrey Smith. The Export (Publications) Department of The British Council sent the first three issues of *British Books to Come*. The British Air Commission in Washington added 39 *British Air Ministry Translations* to those previously given. The Republic Aviation Corporation gave four colored lithograph prints of the P-47 Thunderbolt fighter airplane.

Additional gifts were received from the British Air Registration Board, General Electric Company, U.S. Bureau of Foreign and Domestic Commerce, Office of War Information, War Department, Congressional committees on naval affairs and surplus government property and materials, and the House document room.

New Corporate Member

G & A Aircraft, Inc., Willow Grove, Pa., has recently become a Corporate Member of the Institute. The company is a subsidiary of The Firestone Tire & Rubber Company. It has taken over the facilities of the former Pitcairn Autogiro Company and has continued the rotating wing development work of that concern under contract with the Army Air Forces.

However, the principal product of the company during the last several years has been the CG-4A glider. In addition, the company has produced, in the capacity of either prime contractor or subcontractor, a variety of subassemblies and components of other aircraft, such as control surfaces and engine cowling for training planes.

Sections and Branches

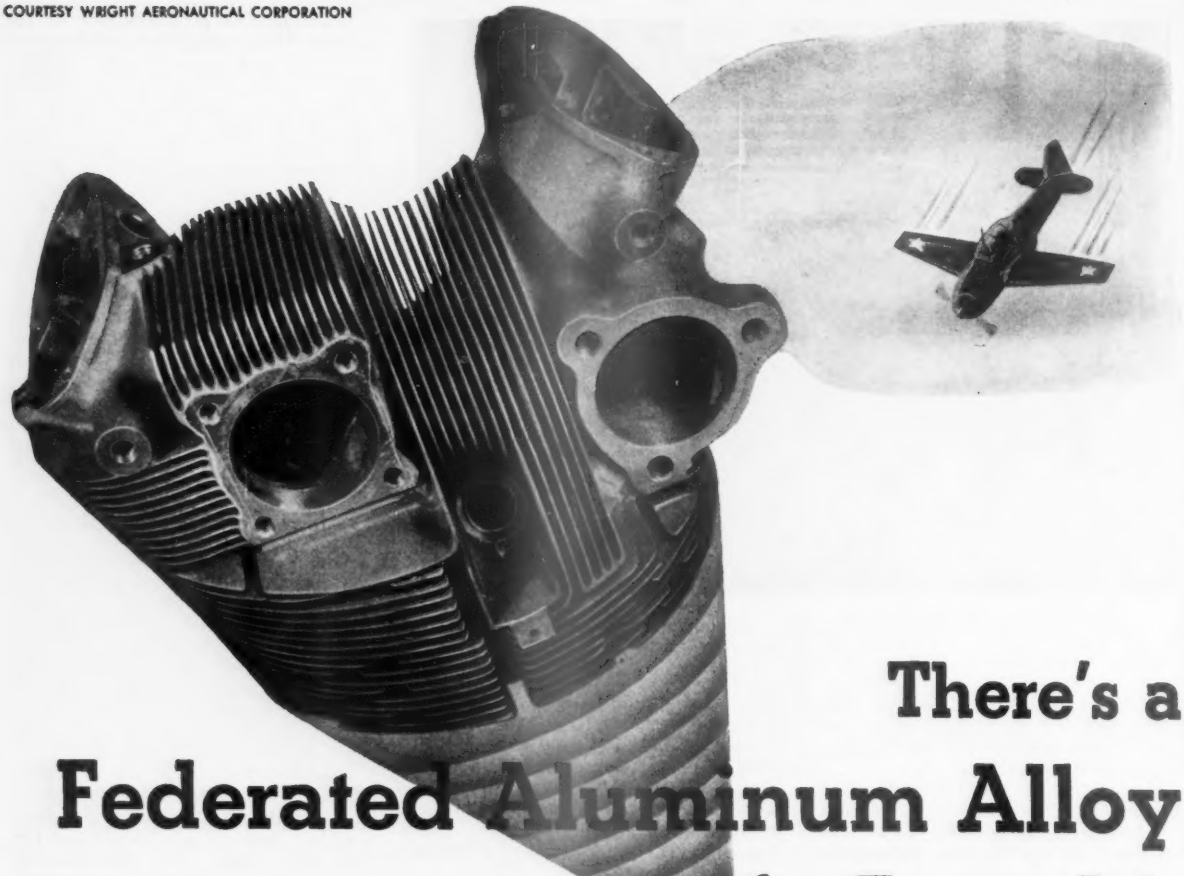
San Diego Section

At a dinner meeting of the San Diego Section on November 1, 1944, Albert A. Arnhym, Consulting Engineer of Solar Aircraft Corporation, spoke about Montgomery's early experiments and pioneer flights with gliders. The meeting was held at the San Diego Women's Club, with 120 Section members and guests in attendance. Among the guests were 40 members of the San Diego Chamber of Commerce, including the Vice-President of the Chamber.

Seattle Section

The first meeting of the Seattle Section for the current fiscal year was held on November 1, 1944. The feature of the meeting was a talk on the "Record of the Stratoliner," delivered by R. C. Loomis, Engineering Supervisor of the Intercontinental Division of Transcontinental and Western Air, Inc. The lecture was particularly interesting to the Boeing Aircraft Company employees present, because many of them had had a part in the designing of the airplane. The talk was followed by informal discussion. The attendance at the meeting was 132.

COURTESY WRIGHT AERONAUTICAL CORPORATION



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Aeronautical University

A meeting of the Aeronautical University Branch was held on November 15, 1944, under the chairmanship of Joseph Gorman, who has resumed his position as Faculty Advisor. New officers were elected as follows: Chairman, Richard Smietanski; Treasurer, Charles Kerbs, Jr.; Secretary, Robert Carlstrom.

University of Detroit

At the first meeting of the current term, held in the Engineering Building on November 16, 1944, the following officers were elected: Chairman, Carl J. Martin; Treasurer, John A. Prokop; Secretary, E. L. Davenport. Instead of appointing a permanent program chairman, two members are appointed at each meeting to prepare the program for the next meeting.

At the November 30 meeting, E. L. Davenport gave a discussion about the taking of notes in the classroom and the organization and filing of such notes for use in preparation for examinations and as an aid in subsequent work in the industry.

University of Kansas

A technical meeting was held on December 7, 1944, with an attendance of 16. D. R. Learned presided, and a talk on "The Aviation Industry" was given by Professor Simpson, the head of the Aeronautical Engineering Department of the University.

Illinois Institute of Technology

A business meeting was held on November 29, 1944, attended by 14 members. Edward J. Goetsch presided. The following new officers were elected: Chairman, Sidney Mayster; Vice-Chairman, Edward Goetsch; Secretary, Albert Spooner; Treasurer, Clayton Blout. A financial statement was given by the Treasurer and seven new members were admitted.

Massachusetts Institute of Technology

With an attendance of 100, a business meeting was held on November 24, 1944, at which Kirk Drumheller presided. A short talk was given by Prof. Richard H. Smith, Faculty Advisor, about the functions of the Institute with special reference to its activities at M.I.T. Following the talk, two non-technical motion pictures were shown, titled *The Story of the Airship* and *The Air Fleet.*

University of Minnesota

A technical meeting was held on October 26, 1944, attended by 60 members. Prof. J. D. Akerman presided. The guest speaker was William B. Stout, who spoke on "Science in Aviation."

On November 20 a business meeting was held with an attendance of 20, at which there was a discussion of plans for increasing the membership, future programs, and a dance.

New York University

The New York University Student Branch recently held an election of officers. The following were elected: Chairman, William Bruning; Vice-Chairman, Mathew Miller; Secretary-Treasurer, Donald Witkin.

North Carolina State College

The following new officers were elected at a recent meeting: Chairman, T. B. Whitehurst; Vice-Chairman, C. E. Grigsby; Secretary-Treasurer, J. W. Brown; Recording Secretary, H. C. Wroton. In addition to these officers, J. S. Hepler was appointed as Engineers' Council Reporter and T. B. Whitehurst as Alternate Representative to the Engineers' Council.

University of Oklahoma

The regular November monthly meeting was held on November 13, 1944, after which the members made an inspection trip through the Oklahoma City plant of Douglas Aircraft Company, Inc. This is one of the plants that builds Douglas C-47 transports and also makes parts for the C-54.

Polytechnic Institute of Brooklyn

The first meeting for the current term of Polytechnic Institute of Brooklyn was held on October 31, 1944. Dr. R. Paul Harrington, Head of the Department of Aeronautical Engineering, gave a brief review of the proceedings at the National Air Transport meeting of the Institute in Washington on October 20.

A technical meeting was held on November 16, with Henry G. Lew, Chairman, presiding. Constantine Dolkas gave a talk on "Lofting Problems" based on his experiences of 1 year in the Lofting Department of Bell Aircraft Company in Buffalo, which he undertook between his Junior and Senior years at college.

The technical meeting on November 21 was attended by 35 members. Victor De Biasi gave a paper on "Load Factors." Peter Thomas was elected Vice-Chairman of the Branch in place of Warren Shields, who left college to enter the armed forces.

Rensselaer Polytechnic Institute

A technical meeting on October 6, 1944, was attended by 60 students and faculty members. Chairman Nichols and Professor Fairbanks presided. A lecture about lighter-than-air craft was given by Lt. Comdr. R. G. Kopff of the U.S. Naval Reserve, an airship pilot and head of airship pilot training at the Lakehurst (N.J.) Naval Air Station. He discussed the theory of airships and the problems encountered in piloting them.

A technical meeting held on November 10 was attended by 60 members and was addressed by Joel Baker, Test Pilot for Curtiss-Wright Corporation, who is an alumnus of Rensselaer Polytechnic Institute. He spoke on aeronautical engineering as seen through the eyes of both the pilot and the engineer. He explained the problems met by a test pilot in testing a production model or an experimental plane and in a demonstration flight test. The lecture was followed by a motion-picture film *How to Fly a P-40.*

A combined technical and business meeting took place on November 24, 1944. The reports of the treasurer and of the secretary were read and accepted. The motion picture *Army Air Forces Report,* comprising five reels of sound pictures, was projected. It includes actual combat pictures of airplanes in action.

University of Texas

At a meeting on November 15, 1944, new officers were elected as follows: Chairman, Merle C. Mueller; Vice-Chairman, Edward Larroca, Jr.; Corresponding Secretary, Thomas J. Lee; Recording Secretary, Marilyn A. Broom; Treasurer, Barney A. Chaudoin, Jr. Ray Lee was appointed Publicity Agent.

Tri-State College

Professor Jones presided over the meeting on October 9, 1944, at which the following officers were elected: Chairman, Gordon Fries; Vice-Chairman, Jack Hoyt; Secretary-Treasurer, Charles Dusheck.

At a meeting on October 16 the following officers were elected to the Student Council: Senior Representative, Charles Kelly; Junior Representative, Donald Roy Spencer. Professor Hohenshau gave a talk about the new developments at the Stout Research Division of Consolidated Vultee Aircraft Corporation.

At the meeting on October 23 Harry Clink, Flight Supervisor for the Civil Aeronautics Administration, gave a talk on some of his experiences as an inspector.

At a meeting on October 30 Charles Richman gave a talk concerning propellers and their operation, with particular reference to the Hamilton Standard hydromatic propeller.

News of Members

Gen. Henry H. Arnold, Commanding General of the Army Air Forces, has been advanced to the new rank of General of the Army. This is a rank equivalent to that of Marshal in the armies of other nations and will be designated by five stars arranged in a circle.

William H. Beardslee has joined the Engineering Staff of The General Tire and Rubber Company's Aviation Division as

Air Power

Through Piston Rings

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PISTONS...PINS...

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McQuay-Norris is definitely air-minded. We are now suppliers of precision parts to the world's largest makers of aircraft motors. Our 34 years' experience in precision manufacture enables us to meet every demand of modern aviation for sturdy, unfailing precision parts. Your inquiries are invited.

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Hardened and Ground Parts

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Piston Rings

EQUIPMENT FOR MAINTENANCE OF AIRCRAFT

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Piston Rings for Oxygen Compressor
Pins for Oxygen Compressor
Pistons for Air Compressor
Pins for Air Compressor
Piston Rings for Air Compressor

LANDING GEAR PARTS

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Piston Rings
Hardened and Ground Parts

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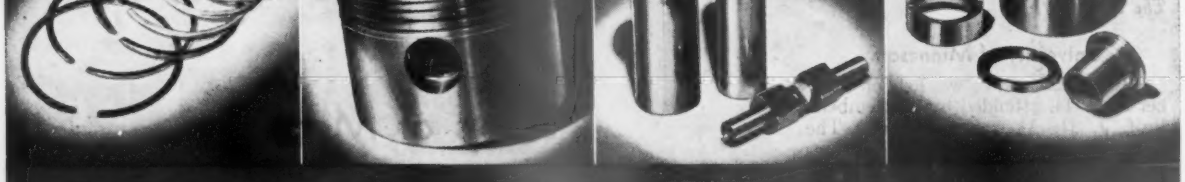


McQUAY-NORRIS MFG. CO. (AIRCRAFT DIVISION), ST. LOUIS, U. S. A.

CANADIAN PLANT, TORONTO, ONTARIO

Project Engineer in charge of aircraft wheels and brakes.

Lawrence D. Bell, President of Bell Aircraft Corporation, was elected to the Board of Governors of the Aeronautical Chamber of Commerce of America, Inc.

Philip G. Blenkush has been commissioned an Ensign in the U.S. Naval Reserve.

Charles I. Bloomer is now in the Development Engineering Department of Consolidated Vultee Aircraft Corporation.

Harry E. Bloomer received his commission as an Ensign in the U.S. Naval Reserve.

Kenneth A. Browne, formerly Research Engineer and Technical Consultant at Wright Aeronautical Corporation, has been appointed to the newly created post of Research Consultant to the presidents of the Chesapeake and Ohio Railway Company; The New York, Chicago and St. Louis Railroad Company; and the Pere Marquette Railway Company.

Perry A. Clark is now a Power Plant Engineer with Transcontinental & Western Air, Inc.

James C. B. Coleman has joined the Royal Canadian Air Force as a Flight Engineer.

H. M. Conway, Jr., has been appointed an Ensign in the U.S. Naval Reserve.

Alex C. Crosman has joined Link Aviation Devices Company as an Engineer.

Donald W. Douglas, President of Douglas Aircraft Company, Inc., was elected Chairman of the Board of Governors of the Aeronautical Chamber of Commerce of America, Inc., at the annual meeting of the Chamber in Washington on December 7, 1944.

Shepard Dudley has been appointed President of Intava, Inc.

Ernest F. Dunford is now with Eastern Aircraft Division of General Motors Corporation as Senior Project Engineer.

William F. Durand, Professor Emeritus of Mechanical Engineering at Leland Stanford University, was reappointed by President Roosevelt as a member of the National Advisory Committee for Aeronautics, to serve for another term of 5 years starting December 1, 1944. He was first appointed by President Wilson in 1915, and served as Chairman of the N.A.C.A. during World War I.

Henry S. Egerton has joined Sikorsky Aircraft Division of United Aircraft Corporation as Senior Layout Draftsman.

Donald J. Elliott is now a Research Engineer with the Halliburton Oil Well Cementing Company.

Elliott G. Emery has become connected with the Installation Engineering Department of the Pratt & Whitney Aircraft Division of United Aircraft Corporation.

Harry E. Foster has joined the Engineering & Research Corporation as an Aeronautical Engineer.

Byron Freeman is now with North American Aviation, Inc., as an Aerodynamicist.

Lloyd R. Gant has been appointed Liaison Engineer with Pratt, Read & Company.

Willard L. Gendron was commissioned an Ensign in the U.S. Naval Reserve.

Paul E. Hovgaard, new Associate Director of the Research Laboratory of Curtiss-Wright Corporation's Airplane Division at Buffalo. Mr. Hovgaard served previously as Director of Flight Test for the Airplane Division.

Palmer A. Hewlett, formerly Washington Representative of Consolidated Vultee Aircraft Corporation, has been appointed Export Sales Director of that company.

Robert H. Hinckley, former Director of the Office of Contract Settlement, has been appointed by President Roosevelt as a member of the War Production Board.

Paul E. Hovgaard has been appointed Associate Director of the Research Laboratory of the Airplane Division of Curtiss-Wright Corporation. He served previously as Director of Flight Test for the Airplane Division.

Kuang H. Hsiao has joined Curtiss-Wright Corporation as a Structural and Testing Engineer.

Jerome C. Hunsaker, head of the Department of Mechanical Engineering and Department of Aeronautical Engineering at the Massachusetts Institute of Technology, has been reappointed by President Roosevelt as a member of the National Advisory Committee for Aeronautics, to serve for a 5-year term commencing December 1, 1944. He has been Chairman of the N.A.C.A. since 1941.

Ely H. Ice has been appointed Quality Field Representative of Curtiss-Wright Corporation.

Simon S. Jackel is now with Fleischmann Laboratories as a Chemist.

Maurice D. Jacobs has joined Ranger Aircraft Engine Division of Fairchild Engine & Airplane Corporation as a Field Installation Engineer.

Felix Kallis, formerly Chief Aeronautical Engineer in charge of Overhaul Activities of Southwest Airways, Inc., has been appointed Chief Process Engineer at the Continental-Denver Modification Center operated by Continental Airlines, Inc.

Joseph M. Kleinman is now a Junior Engineer at the Langley Memorial Laboratory of the N.A.C.A.

C. Raymond Kramer has joined Republic Aviation Corporation as Development Engineer.

Edward Kurzawa is now an Engineer at the Dolan Aircraft Manufacturing Company.

Theodore G. Linnert is now an Engineering Representative with the Air Line Pilots Association.

Arthur Nutt, formerly Vice-President in charge of Engineering at Wright Aeronautical Corporation, has been appointed Director of Engineering in the Aviation Division of Packard Motor Car Company.

John H. Penzlau has become associated with Shaw-Rutan, Inc., as an Engineer.

John W. Rane received his commission as an Ensign in the U.S. Naval Reserve.

Robert F. Rautenstrauch, on leave of absence from North Carolina State College, is a Process Engineer at the Research Laboratory at Curtiss-Wright Corporation.

Donald R. Suchner has been appointed Chief of Flight Test in the Stout Research Division of Consolidated Vultee Aircraft Corporation.

Earl J. Swailes has joined The Glenn L. Martin Company as Production Staff Assistant.

Mann C. Sweet has been appointed Ground Instructor at the Terrell Aviation School.

Harvey C. Tafe, formerly Service Director of Consolidated Vultee Aircraft Corporation at San Diego, has been appointed Washington representative of the company.

Herbert L. Tollisen, Jr., has been commissioned an Ensign in the U.S. Naval Reserve.

Jose L. Velazquez is now an Ensign in the U.S. Naval Reserve.

Eugene E. Wilson, Vice-Chairman of United Aircraft Corporation, was elected President of the Aeronautical Chamber of Commerce of America, Inc.

Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Hoyt, John Robert, Lt. Comdr., U.S.N.R.

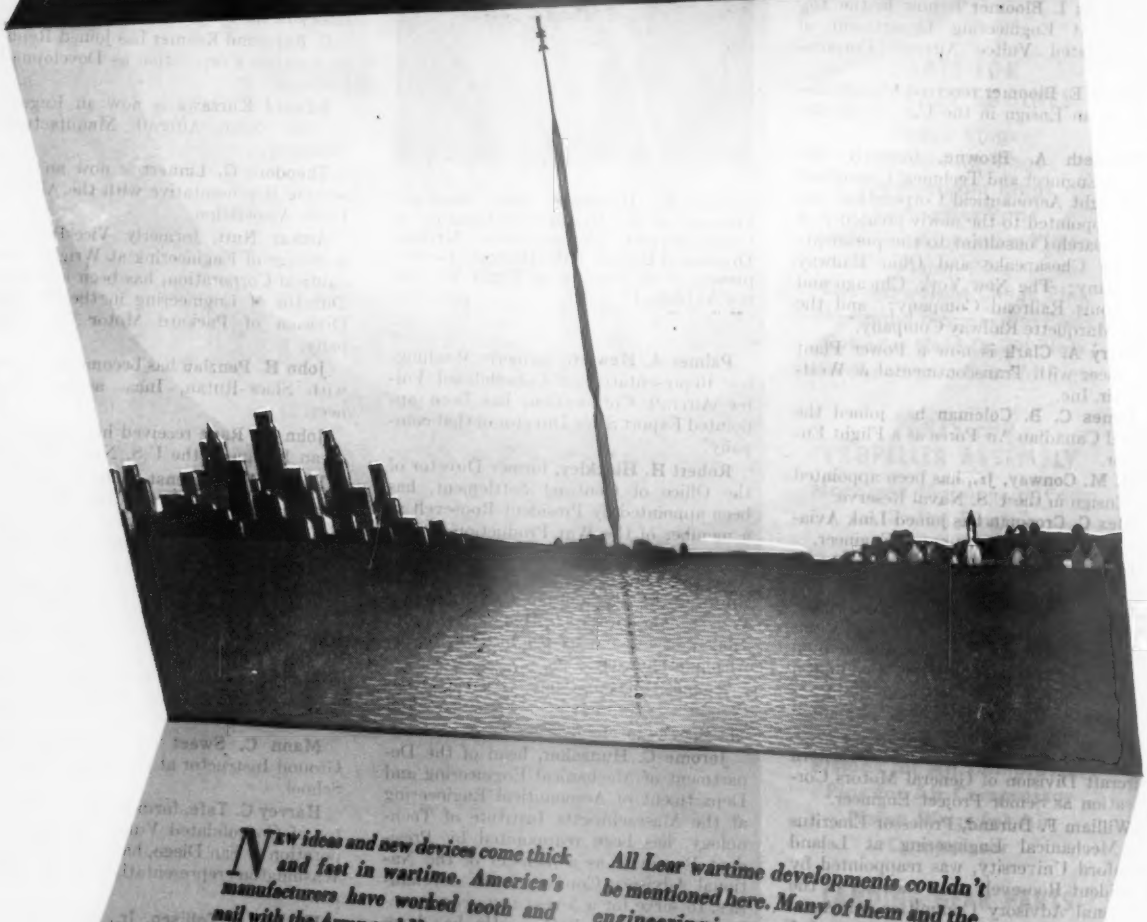
Elected to MEMBER Grade

Beardslee, William Harold J., Project Engineer, The General Tire & Rubber Co.

Blakeley, Richard Harvey, B.S. in Ae.E.; Sr. Stress Analyst, Goodyear Aircraft Corp.

Blakely, William Robert, B.S. in M.E.; Chief of Structural Design, Beech Aircraft Corp.

LOOKING AHEAD



New ideas and new devices come thick and fast in wartime. America's manufacturers have worked tooth and nail with the Army and Navy to produce all the modern equipment the armed forces need.

Among these manufacturers is Lear. The Lear aircraft radio was well known long before the war. It was ready for the armed forces when war came. Then Lear explored new fields and produced the special Lear midget motors, the Fastop Clutch, and Lear Actuators which make it possible to move airplanes' flaps, shutters and landing gears accurately by electricity.

All Lear wartime developments couldn't be mentioned here. Many of them and the engineering ingenuity which produced them will be turned to peacetime conveniences and pleasures.

For example, there will be the new Lear home radios—instruments built with the integrity demanded by aircraft radio, and equipped with features unknown in such sets before.

So while everything keeps going to get wartimes over with, we can afford a look ahead to the bright spots in the peace we have been fighting for.

RADIO DIVISION, GRAND RAPIDS 2, MICHIGAN
Home Radio Sales: 230 East Ohio St., Chicago 11, Illinois

formerly Lear Avia, Inc.

Lear INCORPORATED

Aircraft Radio Sales:
1860 Broadway, New York 23, New York
West Coast Subsidiary: Lear Avia of Calif., Inc., 1010 N. Highland Ave., Los Angeles 38, Calif.

Boutelle, Richard Schley, Vice-President—General Manager, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Courtney, Arthur Wilson, Jr., B.M.E.; Capt., U.S. Army Air Forces.

deGiers, Clarence Adair, President & Chief Engineer, The Liquidometer Corp.

Dickerson, Edward Oakes, B.S. in M.E.; Structural Engineer, North American Aviation, Inc.

Dienstbach, Carl.

Dixson, Bruce Edson, B.S. in Ae.E., Asst. to Los Angeles District Manager, Sperry Gyroscope Co., Inc.

Hoffman, I. Louis, M.D.; Lt. Col., Flight Surgeon, U.S. Army Air Forces.

Huested, Richard Salisbury, B.S.; Manager, Curtiss-Wright Corp.

Jakimiuk, Wsiewolod John, Bachelor of Arts in Aerodynamics; Chief Design and Development Engineer, The de Havilland Aircraft of Canada, Ltd.

Johnson, Jacob Russell, B.S. in Ae.E.; Stress Analyst, Consolidated Vultee Aircraft Corp.

Kaiser, Bernard, Works Manager, Tata Aircraft, Ltd. (India).

Kates, Richard Jay, B.S. in M.E.; Sr. Layout Draftsman, Kellett Aircraft Corp.

Kenny, Geves George, Group Leader, Engineering Dept., Goodyear Aircraft Corp.

Lewis, William Lawrence, Aeronautical Industrial Engineer, Adel Precision Products Corp.

Lipscomb, Woodrow W., A.B., Major, U.S. Army Air Forces.

McCloy, Robert Winston, B.S. in M.E.; Asst. Prof. of Aeronautical Engineering, University of Kansas.

Meyers, Donald Newton, B.S. in M.E.; Mechanical Design Engineer, P-V Engineering Forum, Inc.

Selikoff, William, B.S. in M.E., B.S. in Ae.E.; Engineer-in-charge (Modification Center), Bell Aircraft Corp.

Smull, Thomas Leland Kemp, B.S. in Ae.E.; Technical Asst. to the Chief of Research Coordination, N.A.C.A. (Washington, D.C.).

Thomas, Edward Utley, B.S. in E.E.; Electrical Engineer, Specialties, Inc.

Thorud, Bert Marshall, Sr. Stress Analyst, Goodyear Aircraft Corp.

Vogel, William Theodore, Designing Engineer, Consolidated Vultee Aircraft Corp.

Wang, Yu-Ching, B.S.; Engineering Officer, Commission on Aero. Affairs, Republic of China (New York).

Transferred to MEMBER Grade

Adler, Rudolph Clemens, A.B. in M.E.; Chief Engineer, All American Aircraft Products, Inc.

Arkawy, Seymour Milton, B.A. in Ae.E.; Wing and Tail Group Leader, Fleetwings Div., Kaiser Cargo, Inc.

Binegar, Lewis Albert, B.S. in General Engineering; Service Engineer, Curtiss-Wright Corp.

Brace, Floyd Robert, B.S. in M.E.; Engineer, Boeing Aircraft Co.

Burkhardt, Frank, Structural Design Engineer (Arizona Div.), Goodyear Aircraft Corp.

Crenshaw, Charles Sterling, LL.B.; Research Asst., Wayne University.

Crowell, William Eleazor, B.S. in M.E.; Head, Altitude Chamber Section, Airplane Div., Curtiss-Wright Corp.

Emmerson, John Outram, B.A.Sc.; Jr. Engineer, The de Havilland Aircraft of Canada, Ltd.

Flint, Fred Herman, B.S. in Ae.E.; Adm. Asst. to Director of Flight Test, Airplane Div., Curtiss-Wright Corp.

Hunter, Paul Albert, B.S. in M.E.; Langley Mem. Aero. Lab., N.A.C.A.

Kisselberg, Ervin Thomas, B.S. in M.E.; Structural Test Engineer, Boeing Aircraft Co.

Kittrell, Oliver Terry, Jr., Lt., U.S. Army Air Forces.

Lane, Jack Junior, Supervisor of Technical Information, Cleveland Aircraft Div., General Motors Corp.

Lesk, Norman, Asst. Group Leader, Engineering Dept., Fleetwings Div., Kaiser Cargo, Inc.

MacArthur, Arthur, Jr., Draftsman, P-V Engineering Forum, Inc.

Marchetti, Robert Marion, B.S. in Ae.E.; Sr. Aerodynamicist, The Glenn L. Martin Co.

Schliestett, George Van, M.S. in Ae.E.; Lt. Comdr., U.S.N.R.

Elected to Industrial Member Grade

Butz, August Robert, B.S. in C.E.; District Airport Engineer, C.A.A.

Hull, Leslie, Washington Representative, Romec Pump Co.

Layman, Harold Leslie, B.S. in C.E.; Inspector of Engineering Materials (Aero.), U.S. Navy.

Levine, Milton Israel, Experimental Tool & Process Engineer, Fleetwings Div., Kaiser Cargo, Inc.

Pierrot, Albert Ogden, B.S.E.; Civil Air Attache, Dept. of State.

Squier, Carl Browne, Vice-President, Lockheed Aircraft Corp.

Wright, Robert Hill, Service Engineer, Aluminum Co. of America.

Elected to Technical Member Grade

AuWerter, Frederick Eugene, Engineering Aid, Aircraft Engine Research Lab., N.A.C.A.

Barmby, John Glennon, B.S. in Ae.E.; Aeronautical Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Mendelson, Marvin Bertram, Chief Tool Engineer, The de Havilland Aircraft of Canada, Ltd.

Napieralski, Bernard Andrew, B.S. in Ae.E.; Lt., U.S. Army Air Forces.

Palmer, Paul Augustus, B.S. in M.E.; Engineering Draftsman "A," Douglas Aircraft Co., Inc.

Parker, J. Snead, Group Leader & Liaison Engineer, Goodyear Aircraft Corp.

Petrides, Thracy, B.S. in Ae.E.; S 2/C, U.S. Navy.

Phillips, Robert Bertram, Aircraft Instructor, U.S. Navy.

Rubin, Herman, B.S. in C.E.; Stress Analyst, Consolidated Vultee Aircraft Corp.

Schneck, Curtis Elias, B.S. in M.E.; Stress Analyst, G & A Aircraft, Inc.

Strohmeyer, William Ernest, B.S. in Ae.E.; Aerodynamicist, Consolidated Vultee Aircraft Corp.

Witmer, Emmett Atlee, B.S. in Ae.E.; Engineer, Aircraft Engine Research Lab., N.A.C.A.

Wons, Herman Anton, Engineer Salvage Supervisor, Curtiss-Wright Corp.

Transferred from Student to Technical Member

Block, William Ellis, B.A.E.; Pvt.; U.S. Army Air Forces.

Brinich, Paul Frank, Jr., B.Ae.E.; Aeronautical Engineer, Aircraft Engine Research Lab., N.A.C.A.

Conlin, John Anthony, Jr., B.S. in Ae.E.; Midshipman School, Cornell Univ.

Dodds, Robert P., B.S. in Ae.E.; U.S. Navy.

Eggers, Alfred John, B.S. in M.E.; Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Farinella, John Arthur, U.S. Army Air Forces.

Kobara, Towru, B.S. in M.E.; U.S. Army Air Forces.

Kucharski, Edward Francis, Engineering Draftsman, Chance Vought Aircraft Div., United Aircraft Corp.

Lamela, Alfredo, B.S. in Ae.E.; Lt., Uruguayan Air Corps., Maintenance Engineer, Direccion Gral. de Aero. Militar (Uruguayan Embassy), Washington, D.C.

Lockwood, Raymond Marshall, B.S. in M.E.; Lt., U.S. Army Air Forces.

McLean, George Davidson, B.A.E.; Pvt., U.S. Army Air Forces.

Nathanson, Theodore Herzl, B.S. in A.E.; Engineer, Noorduyn Aviation Ltd.

Neuss, Waldemar, B.A.E.; Engineer, Panair do Brasil.

Siegel, Martin, Layout Draftsman, Sikorsky Aircraft Div., United Aircraft Corp.

Snyder, Edwin Glenn, Jr., B.A.E.; Engineer, Douglas Aircraft Co., Inc.

Spalholz, Robert Richard, B.A.E.; Jr. Research Engineer, Republic Aviation Corp.

West, Charles Bernard, B.A.E.; Aerodynamicist B., Consolidated Vultee Aircraft Corp.

Whitty, Joseph Aloysius, B.A.E.; Stress Analyst, Republic Aviation Corp.

Elected to Affiliate Grade

Bell, Charles Norman, Engineering Asst., The de Havilland Aircraft of Canada, Ltd.

Justinger, Robert Joseph, Sr. Service Engineer, Curtiss-Wright Corp.

Necrology

John B. Krusi

John Bernard Krusi, a Technical Member of the Institute, was reported killed in an airplane crash at Prestwick, Scotland, on August 27, 1944, while serving as a member of the Air Transport Command of the Army Air Forces.

What's a pattern maker got to do with **ALUMINUM FORGINGS?**

You've decided on an aluminum forging because of its high strength-weight ratio. But stresses will be complex. You can't be sure of the design until the part is completed, and dies cost a lot of money to make and change. So here's where the multiple interests of Alcoa can serve you:

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A native of New York, where he was born October 12, 1921, he was educated at New York University, where he received his Bachelor of Science degree in 1941 and a Bachelor of Aeronautical Engineering degree in 1943.

Upon completion of his studies, Mr. Krusi joined Curtiss-Wright Corporation as a Junior Engineer in the Transport Contract Department, where he worked on various problems in aircraft design and operation in connection with the company's transport-development program. He left that company to enter the Army Air Forces.

James D. Leedy

James Donald Leedy, a Technical Member of the Institute, died November 13, 1944, at the age of 23. He was born at Portland, Ore., on August 2, 1921. An alumnus of Oregon State College, from which he was graduated in March, 1944, with the degree of Bachelor of Science, he joined Consolidated Vultee Aircraft Corporation and served as an Aerodynamicist at the company's San Diego plant until the time of his death.

Charles S. J. MacNeil

Charles Seward Jadis MacNeil, Jr., a MEMBER of the Institute and Chief Engineer of the Aeroproducts Division of General Motors Corporation since its formation in 1940, died of a heart attack on November 18, 1944. Feeling ill while flying in his cabin plane over Indiana, he landed safely on a farm 18 miles from Brazil, Ind., and died about 15 min. later.

Mr. MacNeil was 34 years of age and a native of Malden, Mass., where he was born June 28, 1910. He was a graduate of the Massachusettes Institute of Technology with the degree of Bachelor of Science in Aeronautical Engineering. After graduation in June, 1933, he joined the then Curtiss Aeroplane and Motor Company of Buffalo, where he was engaged in propeller design with the predecessor of the Curtiss Propeller Division of the Curtiss-Wright Corporation. In 1935 he formed the engineering firm of Blanchard and MacNeil, engaged in propeller development for the Army Air Corps, and in 1937 became Secretary and Engineer of Engineering Products, Inc., of Dayton, Ohio. He later became a lecturer in the Department of Aeronautical Engineering of the University of Michigan.

Max Stupar

Max Stupar, a MEMBER of the Institute and Chief of Industrial Planning of the Georgia Division of the Bell Aircraft Corporation, was killed in an airplant accident at Wright Field on November 27. He was en route from Marietta, Ga., to Buffalo, N.Y., in an airplane piloted by Col. Carl A. Cover, Vice-President of Bell Aircraft Corporation, who also lost his life.

Mr. Stupar was a native of Austria, where he was born December 23, 1885, and became a citizen of the United States in 1894. He was one of the pioneers in aviation, with almost 40 years of active interest in the industry. As early as 1905 he had begun aviation experiments and by 1910 he had built numerous aircraft and gliders of his own design.

From 1910 to 1912 he was the owner and operator of the Stupar Aero Works, which built numerous airplanes of French type and several of his own design. Later, Mr. Stupar became Chief Engineer of the Chicago Aero Works and during the first World War he was Manager of the Standard Airplane Corporation plant in New Jersey.

Early in 1919 Mr. Stupar organized the aircraft division of G. Elias and Brother, Inc., in Buffalo, which manufactured experimental airplanes, several of which won prizes for airplane design offered by the Army and Navy. In 1926 he organized the Production Engineering and Tool Design Division in the Buffalo plant of Curtiss-Wright Corporation and later was the manager of the Production Engineering Division of that company's Garden City plant.

He joined Bell Aircraft Corporation in May, 1940, and was Coordinator of Production at the Georgia plant, later serving as Acting Manager in the Georgia Division.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Aeronautical Engineer—graduate or equivalent in experience. Good working knowledge of airplane design, structure, materials, and stress analysis desirable. Background of naval aircraft specifications and manufacture considered excellent. Pleasing personality is essential. Apply or write to the Bureau of Aeronautics Representative, c/o Edo Aircraft Corporation, 13-10 111 Street, College Point, N.Y.

Aircraft Power Plant Staff Engineer—Minimum, five years' experience on power-plant design and thorough knowledge of thermodynamics. **Aircraft Engineers**—Experienced aerodynamicists, stress analysts, weight engineers, layout draftsmen, and senior detailers. Applicants must comply with W.M.C. regulations. Write full details of qualifications to McDonnell Aircraft Corporation, 1703 Locust St., St. Louis 3, Mo.

Aircraft Engineers—Positions available in Clifton & Caldwell, N.J., for Tool & Gage Engineers. Also engineers for manufacturing process, production methods, also design engineers, Seniors & Juniors. Manufacturing operation sheet writers, designers, tool & gage; gage analysts, tool & gage draftsmen. Applicants must have Aeronautical Industrial Manufacturing experience. Must have certificate of availability. Call in person or write Employment Office, Curtiss-Wright Corp., Propeller Division, 143 Getty Ave., Clifton, N.J.

Detail and Layout Draftsmen, Stress Analysts, and Design Engineers needed for development work in the Engineering Department. Must be citizen, not employed in essential war industry, or have a certificate of availability from the U.S. Employment Service Office or the War Manpower Commission of your area. Address inquiries to Curtiss-Wright Corporation, Airplane Division, Buffalo, N.Y.; Attention: Director of Engineering.

Aeronautical Engineer—Six years' experience, rotor wing aircraft experience desirable, power-plant installation or some design and structural layout experience necessary. Address inquiries to Mr. Enea Bossi, Higgins Industries Incorporated, New Orleans 19, La.

Detail & Layout Draftsmen, Stress Analysts, Design Engineer, Assistant Project Engineer on development work in the engineering department. Address inquiries to Edo Aircraft Corporation, 136-48 Roosevelt Avenue, Flushing, L.I., N.Y.

Graduate Engineer—Draftsman—Excellent immediate and postwar opportunity. Design airplane accessories. Aeronautical experience necessary. Particular reference to work in hydraulics and alighting gear. Engineering draftsman, with or without aeronautical background, also desired. Write direct, stating education, experience, age, and draft status to Mr. Robert D. Spencer, Manager, Aeronautical Sales & Engineering Department, The General Tire & Rubber Company, Akron, Ohio.

Aerodynamics Engineer—Practical experience wanted by well-known long-established mid-west manufacturer to conduct technical research and market development in ventilating and air-cooling division. Attractive salary for man of ability and ambition. Address inquiries to Box 275, Institute of the Aeronautical Sciences.

Mechanical, Chemical or Metallurgical Engineer, experienced in fabricating and bonding aluminum alloys, to function as project engineer in conversion of copper exchange heat devices to all aluminum construction for aircraft applications. Mid-west location, position permanent. Salary

control

Electrol's Follow-Up Valve is extremely light, weighing only 20 oz. The well known balanced poppet type Electrol Selector Valve mechanism assures dependability.

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Originally designed for Wing Flap installation, it is equally valuable to such other uses as carburetor, rudder or any service where smooth, accurate and complete control is required.

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commensurate with experience and ability. Address inquiries to Box 271, Institute of the Aeronautical Sciences.

Contact Man—to aircraft industry, travel mid-west and east representing manufacturer of heat transfer equipment. Engineering and previous contact with aircraft industry desirable but not essential. State background and previous employers and enclose photo. Address inquiries to Box 266, Institute of the Aeronautical Sciences.

Aero & Mechanical Engineers—Large engineering firm engaged in military work with growing backlog of postwar jobs needs engineering personnel in all categories: Designers, Layout & Detail Draftsmen, Stress Analysts, Checkers, etc. Location Manhattan. W.M.C. rules observed. Address inquiries to Box 263, Institute of the Aeronautical Sciences.

Chief Design Engineer—Graduate mechanical engineer, experienced on automotive radiators, with established AAA-1 high production manufacturer or automotive radiators. Worth-while salary. Sound peacetime future with resumption of automobile production. Write in complete detail. Enclose recent (non-returnable) photo. Address inquiries to Box 252, Institute of the Aeronautical Sciences.

Industrial Engineers—Major coast to coast air line, strong background on accounting systems, operating cost accounting and capital items depreciation; must be willing to leave city. Permanent position offering unlimited opportunity. Describe background in detail. Enclose photo. Address inquiries to Box 240, Institute of the Aeronautical Sciences.

AVAILABLE

Aeronautical Engineer—B.S.M.E., A.E., three years' experience with Technical Development Division, C.A.A., and two years' experience in aerodynamics of helicopters with Aircraft Engineering Division, C.A.A., desires responsible position with postwar future in aircraft company located in or near New York City. Address inquiries to Box 277, Institute of the Aeronautical Sciences.

Engineer—B.Ae.E., recent graduate, presently employed in material and process group of leading aircraft manufacturer, unmarried, draft deferred, willing to travel, can obtain release from present employer. Desires position primarily concerned with dealing with people but requiring a technical background. If such position is available please contact and résumé will be furnished immediately. Address inquiries to Box 276, Institute of the Aeronautical Sciences.

Engineer—Three years college, 27 years old, rotating wing experience. Desires change to larger plant. Work in research desired. Married and retired 1st Lieutenant from Air Corps. Also a licensed navigator with 800 hours of ocean flying. Address inquiries to Box 274, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Responsible for the development of several successful aircraft, desires additional design or supervision work under contract. Address inquiries to Box 273, Institute of the Aeronautical Sciences.

Aeronautical Engineer—A graduate engineer with 14 years' continuous aircraft experience in research, development, and design of military and commercial airplanes desires connection offering immediate and postwar opportunities. Past experience included positions as Project Engineer, Chief Project Engineer, Assistant Chief Engineer, and Chief Engineer. Has demonstrated ability to organize and supervise engineering departments and to maintain direct responsibility for important experimental and production airplane design projects. Prefers position where technical knowledge and the attainment of close Engineering-Production cooperation is required. Address inquiries to Box 272, Institute of the Aeronautical Sciences.

Aeronautical Engineer and Pilot—B.S. and M.S.E., Commercial Pilot, three years' experience in flight-test work involving handling characteristics of a variety of airplanes. Can get full release for position that involves flying. Would prefer position where engineering and flying can both be used. Address inquiries to Box 270, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Several years' experience in the design of both wood and metal air frames. Has served as Group Leader of Electrical Group. Thoroughly familiar with circuit work and aircraft electrical equipment. Permanently draft deferred. Release from present position can be secured. Desires position with promise of postwar future and permanence with Eastern aircraft concern. Address inquiries to Box 269, Institute of the Aeronautical Sciences.

Pilot—Commercial, C.A.A. Instrument and Instructor ratings. Two Army Reg. 50-3 Instrument ratings. SeL 110–675 HP. Total 2,000 hours including 110 hours instrument time. 60 hours Link. Single engine (BT-13, AT-6), twin-engine and some primary trainer time. Graduate A.A.F. Instructor's School Instrument Pilot, Bryan, Texas. Experience teaching instrument flying. Also 4½ years' engineering experience specializing in Weight and Balance control large aircraft manufacturer. One year's experience as aeronautical ground instructor. Aeronautical engineering education. Member Air Corps Enlisted Reserve. Desires flying job offering continued ERC status or deferment. Age 27, married, two children. Address inquiries Box 268, Institute of the Aeronautical Sciences.

Power Plant Development Engineer—Six years' experience in research, design, and development. Familiar with the aerodynamic, thermodynamic, and metallurgical aspects of gas turbine development. Address inquiries to Box 267, Institute of the Aeronautical Sciences.

Aircraft Factory Executive—Under 40; 17 years' aeronautical experience; broad background. Been Factory Manager, Research Chief, Quality Manager, and Chief Inspector for reputable U.S. aircraft manufacturers; also C.A.A. inspector. Experienced on rotating wing, amphibious, and conventional aircraft; Army, Navy, and Commercial standards; metal, wood, and plastic construction; modern managerial and production methods. Nine Federal Licenses. Proven research and inventive ability; some sales (about 50 airplanes), piloting (1,700 hours), radio (4 stations), and yachting experience. Want management position with progressive company (preferably making helicopters, amphibians, or private owner airplanes). Take up to 50 per cent of salary in company stock. Now in East. Statement of availability, and best of references. Address inquiries to Box 265, Institute of the Aeronautical Sciences.

Engineer-Test Pilot—M.S. in Physics, M.S. in Aeronautics. Two years' experience with aircraft manufacturer as test pilot and design engineer. Five years' experience air-line pilot; latter 2 years as air-line test pilot and Captain on transoceanic operations. Change contemplated because of termination of military contracts. Address inquiries to Box 264, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. in M.E., M.S., 1½ years' experience in stress analysis of private airplanes, 6 years' experience in supervisory capacity with one major aircraft concern including 5 years of stress analysis and structural design of experimental and production Army and Naval aircraft and one year of static testing and structural research. Desires position in vicinity of New York City with consultant or with company having postwar plans for the development of personal airplane. Address inquiries to Box 262, Institute of the Aeronautical Sciences.

Electrical Engineer—Graduate, age 30, family. Eight years' experience leading aircraft companies in design and research on electrical, radio and instrument components. Five years as a section head in the above capacities. Thoroughly familiar with related aircraft engineering problems. Desires responsible position having good postwar possibilities. Prefers vicinity of Los Angeles, South Amer-

(*Continued on page 139*)

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They help combat planes fly higher, faster, farther.
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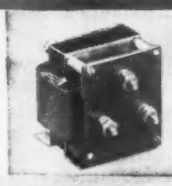
Single-phase to Three-phase Transformer

Operates one Type KB-1 and one Type KC-1 gyro instrument simultaneously
Input: 115 volts, 400 cycles, single-phase
Output: 115 volts, 400 cycles, three-phase
Ask for Bulletin GEA-4118

Two-phase to Three-phase Transformer



Operates Types KB-1 and KC-1 gyro instruments in aircraft equipped with 750-va Holtzer-Cabot inverter
Input: 26 volts and 115 volts
Output: 115 volts, three-phase, 400 cycles
Ask for Bulletin GEA-4113

Three-phase to Single-phase Transformer

Provides single-phase power for operation of the radio compass and other instruments and accessories
Input: 115 volts, 400 cycles, three-phase
Output: 115 or 26 volts, 400 cycles, single-phase
Ask for Bulletin GEA-3881

Ballast and Transformer

Operates two or four 4-watt MAZDA F lamps for instrument, indicator and panel lighting; also provides 3 volts (5 or 10 amp) for indicator and instrument rim lights
Input: 110 volts, 400 cycles
Ask for Bulletin GEA-3859

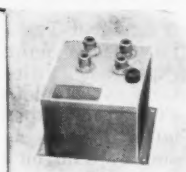
Core-and-coil Ballast

Will operate one 4-, 6-, 8-, 15-, or 20-watt MAZDA F lamp for fluorescent lighting of commercial aircraft, depending upon rating selected
Input: 118 volts, 400 cycles
Ask for Bulletin GEA-3860

Enclosed, High-power-factor Ballast

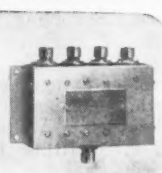
Will operate one 15-, one 20-, or two 30-watt MAZDA F lamps for general cabin lighting aboard commercial aircraft, depending upon rating selected
Input: 117 or 203 volts, 400 cycles
Ask for Bulletin GEA-3866

Inverter Ballast (d-c to a-c)



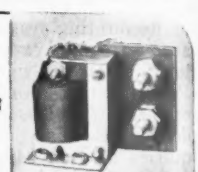
Provides suitable output voltage for operation of two 4-watt MAZDA F lamps for instrument-panel lighting; also provides 3 volts (1.5 amp) for operation of indicator lights
Input: 12 or 24 volts, d-c
Ask for Bulletin GEA-3907

Enclosed Ballast



Operates four 4-watt MAZDA F lamps for instrument-panel lighting
Input: 26 volts, 400 cycles
Ask for Bulletin GEA-3908

Autotransformer

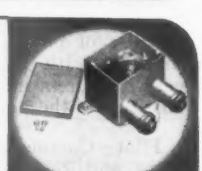


Furnishes proper a-c voltage for operation of 400-cycle aircraft instruments, such as the remote indicating compass
Input: 110 to 120 volts, 400 cycles
Ask for Bulletin GEA-4260

Ignition Booster Coil (d-c)

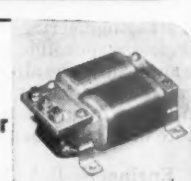
Provides ample and positive spark for starting aircraft engines at low magneto speeds
Input: 12 and 24 volts, d-c
Ask for Bulletin GEA-3861

Starting Vibrator



Provides pulsating, low-voltage current directly to the low-voltage winding of the magneto for instant starting of the engine
Input: 1.8 amperes at 24 volts, d-c
Ask for Bulletin GEA-4105A

Single-phase Autotransformer



Provides proper voltage for operation of 28-volt lamps, electrically heated flying suits, and other low-voltage accessories on aircraft
Input: 120 volts, 400 cycles
Output: 30 volts (open circuit)
Ask for Bulletin GEA-4319

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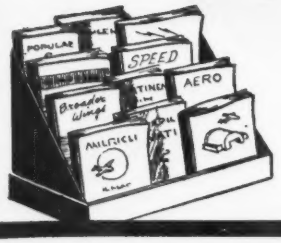

Periodicals

Accessories and Equipment

Problems in Pressurizing Aircraft Cabins. D. D. Waller. The writer briefly discusses past developments and experiments in cabin pressurization and considers human physiologic requirements at high altitudes. Advantages of the pressure-cabin principle for commercial airplanes and military usage are then enumerated. Considerations of major importance which must be dealt with in the design of a pressurizing system for flight personnel are discussed. These include the danger of complete pressure failure and of leaks in the cabin. Another problem is considered—that of ventilating the cabin while attempting to maintain pressure within it. Development work done by Consolidated Vultee Aircraft Corporation on pressure cabins and equipment is described. A typical calculation of cabin pressures is shown. Other subjects discussed include the mechanical-drive supercharger pressurizing system and estimates of its performance, heat losses, air flow, and dual-cabin pressure systems. *Industrial Aviation*, November, 1944, pages 7, 8, 10, 12, 13, 72, 3 illus.; "Why Pressurized Cabins?" by William C. Hoff, *Flying Aces*, December, 1944, pages 26, 27, 50–52, 6 illus.

The Development of Aircraft Position Lights. Jack Vitol. An explanation of the changing trends in aircraft position lighting and the development work that finally resulted in the use of flashing lights. The writer outlines the history of the work and describes how the Civil Aeronautics Administration interested a Baltimore inventor in developing a device for flashing the taillight. Reference is made to a questionnaire sent to air-carrier operators in 1941 to gather information about the subject, and some of the answers received are given. Tests conducted by the National Bureau of Standards with units designed to permit two lights to be flashed at different cycles and eclipse periods are described. Information is given regarding the part American Airlines, Inc., played in the development that led to the present scheme of flashing lights. *Electrical Engineering*, November, 1944, pages 796–798 (Transactions).

High-Flying Oxygen Valve. Irvine G. Goddard and I. Goldberg. This articles describes the development of a demand valve that requires no manual control and that provides airmen with a constant supply of oxygen at any altitude. Woodflour-filled phenolic molded plastics were chosen for the valve body because of certain enumerated advantages. The principles of operation of the valve and its construction are explained. *Modern Plastics*, November, 1944, pages 110, 111, 210, 4 illus.

Aerodynamics

An Extension of the Analogy Between Momentum and Heat Transfer. Arthur N. Tifford. The writer presents mathematical developments that indicate that an analogy exists between the momentum loss in the boundary layer and the rate of heat transfer. The developments also indicate that the quite commonly assumed analogy between skin friction and heat transfer is invalid except when the skin friction is wholly attributable to momentum loss in the boundary layer, as in the case of a flat plate aligned with the free stream. The local heat-transfer coefficients of a laminar boundary layer may be determined by the use of the analogy between momentum loss and heat transfer. It is stated that the analogy should prove to be particularly useful in the analysis of aircraft deicing problems. *Industrial Aviation*, November, 1944, pages 62–64, 66–68, 76, 6 illus.

Air Cargo

Export Air Express Shipments Minus Complications. George F. Bauer. The writer recommends the services of a competent and reliable foreign freight forwarder or customs broker for expediting air-cargo shipments. He explains why the intricate details relating to permits, declarations, consular rules, and other formalities require the attention of a specialist. *Distribution and Warehousing*, November, 1944, pages 45, 74, 76, 1 illus.

A Basis for Air Cargo Rates. Part I. John H. Frederick. This is Part I of a continued article in which the writer suggests a basis for establishing air-cargo rates. He includes information intended to help executives who buy shipping, handling, warehousing, and distribution services and supplies to understand the air-cargo rate problem. In the first installment the writer introduces the general subjects under discussion and then considers theories governing the establishment of rates based on costs of operation. Figures for

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Welding . . . 99

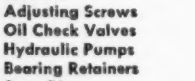
When the record is written

AMERICAN fighting men—*first.* American-made equipment—for them and their allies—*second.* That is a winning combination. And the records will prove it. ★ Eaton is helping to provide the armed forces of America and her allies with vast quantities of fighting equipment—the best the world has ever seen. ★ Eaton manufacturing facilities have been doubled—employment tripled—since our entire resources were dedicated to Victory four years ago. ★ Our production processes have been improved and speeded up. Our already high precision standards have become even more exacting. ★ It is with a sincere feeling of pride in the part we are playing, that we list here some of the Eaton-built war material which, in the hands of well trained fighting men, is doing so much to bring about the destruction of the enemies of freedom.

FOR AIRPLANES

Sodium-Cooled Valves
Propeller Shaft Assemblies
Crankshafts
Valve Tappets
Gasoline Tank Caps
Valve Seat Inserts
Coil Springs
Hydraulic Valve Lifters
Fly Weights
Washers
Adjusting Screws
Oil Check Valves
Hydraulic Pumps
Bearing Retainers
Snap Rings
Ball Ends and Sockets
Forgings
Stampings
Bolts
Bushings
Various other engine parts

FOR NAVAL SHIPS



Bilge Pumps
Engine Valves
Tappets
Valve Seat Inserts
Retainer Rings
Spring Lock Washers
Hydraulic Valve Lifters

FOR ARMY TANKS

Volute Springs
Drive Sprockets
Track Pins
Rotor Pumps
Forced-Draft Ventilators
Engine Valves
Castings
Valve Seat Inserts
Tappets
Coil Springs
Spring Lock Washers
Snap Rings
Manhole Covers
Retainer Rings
Various other engine parts

Every American-built airplane, tank and combat vehicle on every fighting front contains Eaton-made parts. After Victory, as in pre-war years, automobile and commercial trucks will be more dependable, easier-riding, longer-lasting because of the Eaton parts built into them—the results of thirty-three years of close association with the automotive industry.

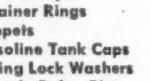
EATON

EATON MANUFACTURING COMPANY
General Offices: Cleveland, Ohio

FOR MILITARY VEHICLES

Axles
Leaf Springs
Castings
Engine Valves
Stampings
Snap Rings
Valve Seat Inserts
Hydraulic Valve Lifters
Coil Springs
Rotor Pumps
Retainer Rings
Tappets
Gasoline Tank Caps
Spring Lock Washers
Throttle Delay Pistons
Radiator Caps and Necks
Gear Shift Levers

FOR GUNS AND AMMUNITION



Bofors Gun Carriage Axles
Bullet Core Rod
Armor-Piercing Shot
Recoil Springs
Detonator Cups
Castings
Stampings
Compression Springs

Plants: CLEVELAND • DETROIT • SAGINAW • MARSHALL • BATTLE CREEK • LAWTON • VASSAR • MASSILLON • WINDSOR (Canada)

air-cargo operating expenses are tabulated. *Distribution and Warehousing*, November, 1944, pages 37, 38, 68, 69.

An Industrial Traffic Manager Looks at Air Cargo. John Mathews. The writer states that the practical necessity of immediate preparations for the part air transportation may play in the business of their companies is not fully appreciated by many industrial traffic managers. It is believed that air cargo will necessitate the realignment of methods of marketing and distribution. Methods of routing inbound raw materials may also be changed. The industrial traffic manager must study packaging methods that will be changed to meet the requirements of air cargo. It is also stated that the traffic manager should reach workable conclusions in connection with the establishment of a practical and equitable system of freight classifications and rates, which must be established on their own merits rather than on the relationship to other modes of transportation. The traffic manager must decide the extent to which inbound and outbound materials processed by his plant can be carried advantageously by established air lines. He must also reach certain conclusions that will enable him to decide the extent to which air cargo can be used to advantage after the war. *Distribution and Warehousing*, November, 1944, pages 20–22, 69, 70.

Air Power

Air Power in Burma. Major F. A. de V. Robertson. The part played by air power during the 1944 campaign in Burma is recorded. Details about Allied air organization and the equipment employed by the different Commands are followed by an account of how Anglo-American air forces helped to foil Japanese attacks. The use of air transport to transfer troops, as well as equipment, is noted. Commendatory mention is made of General Wingate's "Chindits," among other units. *Flight*, October 12, 1944, pages 399, 400, 1 illus.

Air Transport

Railway Air Services. A résumé of the plans proposed by British railways for an air network over Great Britain and Europe. As announced in Parliament, the official railway proposal is: (1) to operate over all the main and subsidiary routes without subsidy, on the assumption that, by agreement between governments, no subsidies will be granted to anyone in the European field; (2) to form a new company to operate the network; (3) to offer partnership with other air operators and with short sea-shipping interests who operated regular surface routes before the war similar to their own cross-Channel services; (4) to give the public complete interavailability of tickets over their land, sea, and air network; (5) to buy British equipment as soon as it is available. Information is given in the article regarding routes that will be covered, equipment that will be used in the initial stage of the operation, and time schedules that will be followed. Reasons upon which the railways base their claims to participate in air service are outlined. *Flight*, October 26, 1944, pages 444–446, 1 illus.

Air Mail—Its Past, Present and Future. Frank C. Walker. The Postmaster-General reviews past experience with air-mail service, describes present problems connected with maintaining an expeditious postal service, and discusses future air-mail developments. He states that the Post Office Department will encourage and assist the development of aviation, but he expresses doubt that aircraft will supersede short-haul surface transportation immediately after the war. He notes that domestic air-mail service is on a fully self-sustaining basis, with revenues in excess of expenses, and that it is an accepted feature of American life. *Air Transportation*, October, 1944, pages 18–20, 1 illus.

America's World Air Routes. Charles Wilson. The international air routes recommended by the C.A.B. and approved by the United States Government are described, and an account is given of the events that led up to the projection of the postwar airways system. Three trunk routes are proposed, with one United States carrier considered sufficient for each. The routes are (1) New York, via Botwood, with a subdivision to Horta, Foynes, Amsterdam, Berlin, Prague, and Warsaw; another to Reykjavik, with a subdivision to Oslo, Stockholm, Helsinki, Leningrad, and Riga; and a third subdivision to Copenhagen, Hamburg, and Berlin. This route would serve Holland, Scandinavia, North Germany, Czechoslovakia, the Eastern Baltic States, Poland, and European Russia. (2) New York, Botwood, Horta, Foynes, London, Brussels, Vienna, with a branch from there to Budapest, Bucharest, Istanbul, Damascus, and Lydda and another subdivision to Belgrade, Sofia, Athens, Alexandria—this line would serve Britain, Central Europe, and the Near East and appears to be the most profitable operation. (3) New York, Botwood, Horta, with a branch to Foynes, Paris, Geneva, and Marseilles and another branch to Lisbon, Madrid, Barcelona, and Rome—this route would reach Portugal, Spain, France, southern Germany, Switzerland, and Italy.

For this service pattern, 60 four-engined planes of 8,800-lb. pay-load capacity each are proposed for over-ocean flights and 23 twin-engined aircraft of 5,000-lb. pay-load capacity for intra-European service. Route segments would be less than 1,500 miles. A map of the outlined air routes illustrates the article. *Flying*, December, 1944, pages 32, 33, 92, 96, 100, 1 illus.

How Much Competition? Part II. B. E. Cole. In this second installment of a two-part article the writer concludes his plea for more competition in the postwar air-carrier industry. The question of whether or not surface carriers should be permitted to operate aircraft is discussed. It is stated that just as the clipper ship gave way to the steamship as the first-class medium of ocean transportation, so the first-class steamship must give way to the airplane. The advantages to be derived from free competition are further discussed. *Air Transport*, November, 1944, pages 48, 51, 52, 54, 59, 4 illus.

The Coming Railroad-Airlines Battle. Part III. Swanee Taylor. Concluding article in a series criticizing the past tactics of the railroads and warning that they will use similar strategy in their attempt to enter the air-transportation fields. In this installment the writer urges the individual reader to add his efforts to opposing the proposed plans for "Integration Carriers." He also lists organizations that are supporting the Air Transport Association in their fight to prevent the railroads from conducting air-line operations. This list includes: The Automobile Manufacturers Association, The National Council of Private Motor Truck Owners, Inc., The Mississippi Valley Association, The American Trucking Associations, Inc., and the Brotherhood of Railway Trainmen. *Southern Flight*, November, 1944, pages 43, 44.

The Air Transport Picture in Its Entirety. William A. M. Burden. The Assistant Secretary of Commerce outlines the function of the Civil Aeronautics Board, the Civil Aeronautics Administration, and the State Department and notes that it is these agencies which in one way or another affect the development of United States air transportation both within its continental limits and on international routes. He then considers various aspects of international air-transport development, including the amount of business it will bring in the future, how it will affect individual ports, and what the ports can do to maintain their position in air trade. *Air Transportation*, October, 1944, pages 8, 9, 12–14; "Airports No. 1 Item," by William A. M. Burden, *Airlanes*, November, 1944, pages 4, 24, 3 illus.

"4-Engined Domestic Plane Needs Crew of 3." F. A. Spencer. The question of what is the most efficient and economical size of crew for a four-engined domestic transport plane in commercial operations is discussed. Following an analysis of the subject, it is concluded that the crew for a four-engined plane in the near future should consist of captain, first officer, and flight engineer. It is stated that since the flight engineer is a vitally important crew member he should have a separate permanent station where he can most efficiently accomplish his routine work. Such a rearrangement would enable the

Eclipse

ELECTRONIC DE-ICER TIMER

FOR USE IN CONJUNCTION WITH ECLIPSE ELECTRONICALLY CONTROLLED MANIFOLD DE-ICER SYSTEM

Flexibility of De-Icer Control

VERY LIGHT ICING CONDITIONS—Turn switch to No. 1 position. After an initial ¼ inch of ice has accumulated on leading edges, but not less than 10 seconds after turning switch, press button and release. De-Icers will operate through one 45-second cycle and stop. Press button and release for additional single cycles when required.

LIGHT TO MODERATE ICING CONDITIONS—Turn switch to No. 1 position, wait 10 seconds, and turn switch to No. 2 position. De-Icers will operate automatically with one-minute intervals between 45-second cycles.

SEVERE ICING CONDITIONS—Turn switch to No. 2 position, wait 10 seconds, then turn switch to No. 3 position. De-Icers will operate automatically with no rest between 45-second cycles.

HIGH ALTITUDE—Turn switch to No. 4 position and De-Icers will operate for 67 seconds, repeating cycle automatically without rest between cycles.

APPLICATION

To effect complete ice removal by the De-Icer method, accretion of ice must be permitted to develop a tensile strength sufficient to overcome adhesion between ice and inflated boot. Accordingly, for effective ice removal, the De-Icer system must be controlled for both rate of accretion and texture of ice formation. The Eclipse Electronic De-Icer Control successfully accomplishes this.

The Electronic Timer is designed for use in conjunction with the Manifold-Solenoid De-Icer System, to open the boot inflating valves automatically, in the proper sequence and for the effective time intervals.

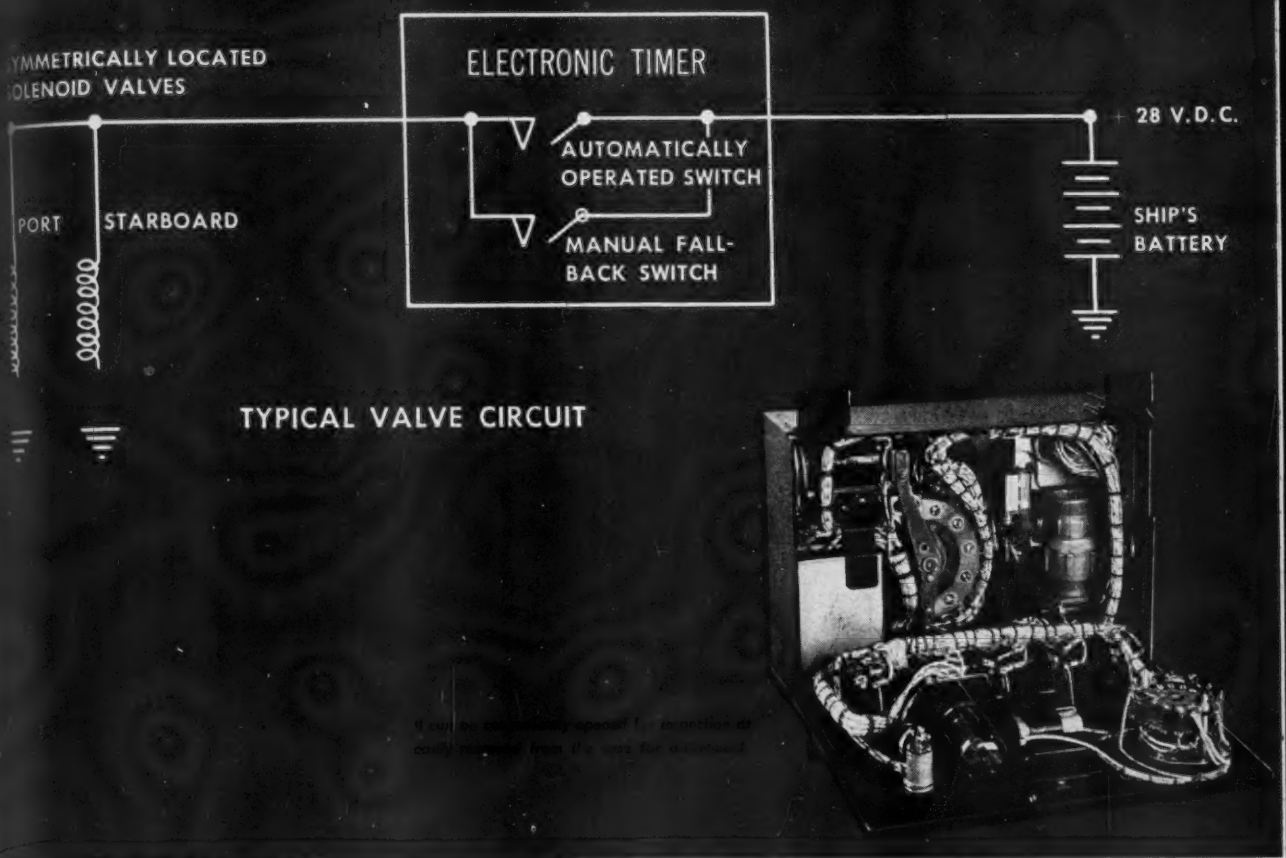
PERFORMANCE

The Eclipse Electronic De-Icer Timer provides automatic or manual remote electrical control of De-Icer boot operation.

BUY MORE WAR BONDS
AND KEEP THE BONDS YOU BUY

ECLIPSE

Eclipse AVI



TYPICAL VALVE CIRCUIT

TO CONTROL THE BOOT VALVES AUTOMATICALLY IN PROPER SEQUENCE AND FOR THE PROPER TIME INTERVALS

The Electronic Timer incorporates a means of controlling frequency and duration of De-Icer operating cycles to suit any type and rate of ice formation.

This flexibility of control is provided in four different variations—"single cycle," "60 second dwell," "0 seconds dwell" and "50% increase."

Purely as a safety fall-back, a row of auxiliary hand-operated switches are provided to operate the valves directly. This switch control permits manual operation of De-Icer cells as required.

DESIGN

In the Eclipse Manifold-Solenoid De-Icer System, single span-wise suction and pressure manifolds provide a simplified, lightweight installation with negligible line losses.

Although primarily designed for *new* aircraft, any manifold solenoid De-Icer System now using the Eclipse *Mechanical* Timer can be inexpensively and quickly converted to the *Electronic* De-Icer Timer and the mechanical timer eliminated, by merely changing the AN connector on the existing cable.

Laboratory tests under room, cold, sea level and altitude conditions show that the Electronic De-Icer Timer will function, without adjustment, for more than 1,000 hours of icing time.

The Electronic De-Icer Timer can be wall or flush panel mounted. It is so designed that it may be opened for inspection from the front while in operation, or for complete removal from the case. Compact design, the unit measures 8⅞" long, 6$\frac{5}{16}$" high, 3¾" deep and weighs 6.5 lbs.

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AVIATION ACCESSORIES

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AVIATION CORPORATION

Old Mother Nature is something of a mechanic herself. Sometimes as we look at the thousands of aircraft gears and beautifully precise parts that flow through our plants we see a striking resemblance to Nature's own uniformity and productivity.

Evolution too, and wise, intelligent design are seen in these man-made flowers of steel, so simple, strong, perfect.

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forward instrument panel to be simplified, thereby making room for new navigational instruments. *American Aviation*, November 15, 1944, pages 66, 68.

Calculating the Effect of Airport Spacing. Part II. Capt. Giles M. Reed. In this second installment of a three-part article on the effects of airport spacing on air-line income, the writer gives equations for estimating the performance of transport aircraft under four different sets of conditions and operating methods. Consideration is given to variables such as usable load, fuel consumption, speed, and lost time. The mathematical processes are explained at length. *Air Transport*, November, 1944, pages 61, 62, 65, 66, 68, 5 illus.

Aviation and Foreign Trade. Eugene E. Wilson. The Vice-Chairman of United Aircraft Corporation emphasizes the great importance of air power, using the words in the broader aspect of peacetime service and not in the narrow meaning of a weapon for war. He states that air power comprises five elements and that of these the heart of air power is air commerce, the sinews are air force, and the backbone is aircraft production. For its remaining two elements air power depends on air bases and airmindedness on the part of the people. The economics of transportation is discussed, and consideration is given to the influence of the airplane on foreign trade. Further technical progress is predicted as a prime factor in the expansion of world commerce. *Air Transportation*, October, 1944, pages 46–48.

Airplane Descriptions

Handley Page Hermes. Specifications and design data are given on the passenger and freight versions of the Handley Page H.P.68 Hermes, new British civil air transport. In addition to marking the structural differences of this plane from the Halifax bomber, the article includes details pertinent to the following components and features: fuselage, wing sections, interior accommodations, flight deck, engines, propellers, landing gear, and heating and air-conditioning equipment. It is reported that the Hermes can carry a pay load of 16,000 lbs. and that its range is up to 2,000 miles. The four engines are Bristol Hercules of 1,650 hp. each, which, with the gross weight limited to 70,000 lbs., give a power loading of 10.6 lbs. per hp. The wing area of 1,408 sq.ft. gives a wing loading of slightly less than 50 lbs. per sq.ft. Wing span is 113 ft. and overall length is 81 ft. 6 in. The top speed is estimated at 340 m.p.h., while an economical cruising speed is placed at 240 m.p.h. Drawings illustrate the interior arrangement of four transport versions: 20 passengers, 34 passengers, 50 passengers, and when fitted for conversion to a sleeper. *Flight*, October 19, 1944, pages 420a–421, 5 illus.; "Handley Page H.P. 68 Hermes," *The Aeroplane*, October 20, 1944, pages 446–448, 9 illus.

First official photo of the top turret of the Northrop Black Widow P-61 night fighter. The revolving turret, on top of crew nacelle, houses four 0.50-cal. machine guns. In addition to this armament, the Widow carries 20-mm. cannon.

American Warplanes. Photographs of U.S. Army and Navy warplanes are accompanied by brief descriptions of each plane. The planes shown are the: SBD Dauntless, F6F Hellcat, TBF Avenger, F4U-1 Corsair, SB2C Helldiver, B-29 Superfortress, B-26C Marauder, A-20G Havoc, B-25J Mitchell, B-24J Liberator, B-17G Flying Fortress, P-38J Lightning, P-39Q Airacobra, P-61A Black Widow, P-63A Kingcobra, P-47D Thunderbolt, P-40N Warhawk, P-51D Mustang, and P-59A Airacomet. *Skyways*, December, 1944, pages 38–53, 24 illus.

Lockheed Offers 14-Place Saturn for Post-War Short Haul Use. A brief article describes important features of the Saturn, a new aircraft designed by Lockheed Aircraft Corporation for feeder operations. It is a high-wing, all-metal, land-based monoplane that will carry 14 passengers, a crew of two, baggage, and cargo. The cruising speed is 200 m.p.h., and the range is 1,600 miles with eight passengers. The top speed is 240 m.p.h. Power is provided by two 525-hp. Continental-built Wright nine-cylinder engines. The take-off distance of the plane is 1,055 ft., and its landing speed of 73 m.p.h. is intended to make it especially adaptable to small airports. It is stated that this aircraft has a rate of climb of 1,230 ft. per min. and a service ceiling of 26,000 ft. and will maintain a 14,200-ft. altitude on one of its two engines. These performance figures are based on a gross weight of 13,500 lbs. A feature of the plane is reported to be interchangeability of parts, including the dual wheels on the main landing gear, the horizontal and vertical tail surfaces, the elevators and rudders, and the stabilizers and fin. The power-plant units may also be changed quickly. *Aviation News*, November 27, 1944, pages 46, 47, 4 illus.

Airports and Airfields

Australia's Inland Flying-Boat Base. This article tells of the establishment of an inland flying-boat service base at Lake Boga, Australia, and of the operations conducted there. The necessity for a repair base in Southern Australia and its strategic value to the Allies are indicated. Some brief comments are given about the base's hangars, workshops, and personnel. *Flight*, October 12, 1944, pages a, b, 397, 398, 10 illus.

Balance the Budget with Hamburgers. The successful experience of Hull-Dobbs Enterprises, Inc., is indicated as an example of the additional airport revenue that may be derived from airport restaurants. Advice is given on the kind of food and service required for air-line travelers, airport personnel, and airport visitors. *Airports*, October, 1944, pages 29, 44, 2 illus.

Progressive Airport Service. Robert C. Blatt. As an example of efficient airport operation, a description is given of the progressive type of service given by the Allentown-Bethlehem Airport. Field rules for eliminating the danger of congestion are listed. A map of the landing field, which is given to each incoming pilot, together with a folder containing the field rules, is shown. *Aviation Maintenance*, November, 1944, pages 54–57, 148, 11 illus.

Heavy-Duty Runway on Poor Ground. Rhodes E. Rule and John F. L. Bate. The construction of the new east-west runway at Lindbergh Field, San Diego, Calif., is described. When completed it will be 8,500 ft. long by 200 ft. wide—one of the longest runways in the United States. It will have taxi strips 75 ft. wide for the entire length of the field. Because the field lies entirely on land dredged from the adjacent bay bottom, careful consideration had to be given to the design of the foundations.

Dredged fill under a sub-base of sand, topped by a crusher-run course of sand and gravel, form the support for a 12- to 14-in. thick concrete runway over soft ground, designed to withstand the load imposed by the heaviest types of airplanes now planned. The runway was laid by three pavers working together followed by a single crew with finishing equipment. Space between the runway and a paved taxi lane is surfaced with asphalt cement and is used to retain water when unusual rainfall exceeds the capacity of the field's drainage system. Details are given concerning the planning of the new runway, the preparation of the ground, the foundation, and the

finishing operations. The machinery used is described and the cost is analyzed. *Engineering News-Record*, November 16, 1944, pages 103–107, 6 illus.

Here's One Airport Contract That Satisfies Both Parties. An example of a satisfactory contract between a fixed-base operator and a municipality is given in the reproduction of the agreement between an operator on Lovell Field and the City of Chattanooga, Tenn. Among other provisions, the contract permits the lessee leeway in making improvements, states the minimum and maximum rates on storage, indicates what maintenance may be expected from the city, and defines the operator's responsibility in the way of repairs, janitor service, etc. *Southern Flight*, November, 1944, page 51.

Where Does the State Fit in Airport Development? Ben Regan. The Chairman of the Illinois Aeronautics Commission propounds the belief that an adequate and well-planned airport-development program is the primary responsibility of a state aviation commission. He demonstrates how the initiation of such a program, the enactment of comprehensive enabling legislation, and the raising of adequate funds for the construction and maintenance of airports can best be carried out by state organization and local communities. On the other hand problems concerning actual flying are stated to be matters that should come under the jurisdiction of a national agency. *Airports*, November, 1944, pages 29, 30.

Airbase Requires Varied Paving Operations. Eudell G. Whitten. Information is given about paving operations connected with the enlargement of the airfield at Fort Dix, N.J. The taxiways and aprons were constructed of Portland-cement concrete. Bituminous concrete was used for runways and bituminous stabilized soil for the shoulders. Comparative data are given on the weight, strength, and control of air-entraining Vinsol resin cement prepared in pavers and truck-mounted mixers. *Engineering News-Record*, November 2, 1944, pages 70–74, 11 illus.

All Way Landings on a Two Way Field. John H. Geisse. Claiming that, in the interests of aviation promotion, airplane design may well be determined by airport limitations, the writer suggests ways in which landing facilities might be made more accessible. To make it possible for airplanes to land at all times on flight strips, the writer indicates the feasibility of redesigning landing gear so that the wheels of a plane will automatically align themselves with the runway regardless of which way the wind is blowing. He also urges the importance of increasing the range of vision from the cockpit, recommends the location of all landing facilities on main highways, and notes the need for eliminating engine noise rather than just soundproofing the cabin. *Airports*, November, 1944, pages 25, 43.

Revenue vs. Costs at Houston Municipal. A statement of the operating expenses and revenue-producing sources of Houston Municipal Airport for 1944. A schedule of airport charges is also included. For 1944, this airport shows an estimated $6,611.86 gross profit on its operation, without allowances for retirement of capital investment or interest on such investment. *Southern Flight*, November, 1944, page 52.

Aiming for New Records in Service and Sales. Arthur W. D. Harris. The organization, expansion, and operation of the Roscoe Turner Aeronautical Corporation, located at the Municipal Airport, Indianapolis, are described. Information is given regarding the hangars, buildings, sales, service, and maintenance methods. Charts show the base organization for service and sales, income to the operator, and income to the airport. *Aviation Maintenance*, November, 1944, pages 39–43, 5 illus.

Turf Can "Pave" the Way! Turf landing fields are advocated as a useful stimulus to local aviation. Although not offered as a comparable alternative to hard-surface runways, it is pointed out that turf fields are a speedy, inexpensive means of providing immediate landing facilities and promoting a greater interest in flying, which will prepare the way for more modern airports with hard-surface runways. Various advantages of turf fields are

It's Time
TO CONSIDER THE MOTOR
FOR YOUR NEW PRODUCT
Our thirty years' experience in the small motor field has proved that the best time to consider the motor is when a new product is in the early stages of development.
At this time, working with your engineering department, we may be able to help you obtain:
(1) greater product compactness
(2) lower product weight
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THOROUGH ENGINEERING is the basic factor behind the successful operation of the special application motors shown here and many others we have designed and built for all types of equipment.
THE LAMB ELECTRIC COMPANY • KENT, OHIO
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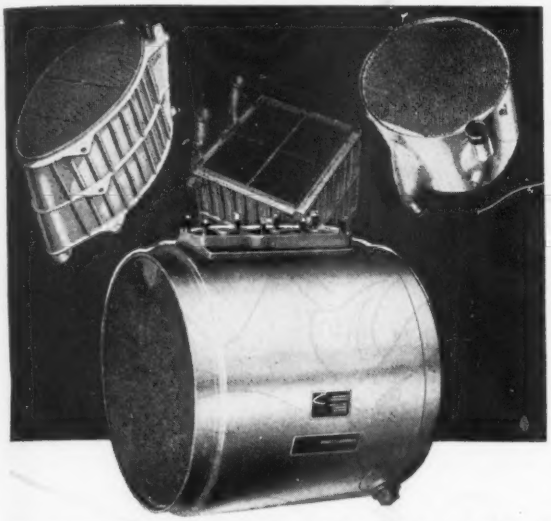
SPECIAL APPLICATION FRACTIONAL HORSEPOWER MOTORS



ALUMINUM BRAZING VS. SOFT SOLDER

A heat transfer unit is only as strong as the bond that fastens its tubes to header plates or shell. The soft solder used for sweating copper units is low in resistance to temperature, pressure, vibration and shear. Silver solder or other high-melting-point solders can't be used because they anneal and weaken the copper at the soldering point.

ADVANTAGES OF ALUMINUM BRAZING

Clifford's discovery of the long-sought method of brazing thin-walled aluminum tubes brought four recognized advantages to heat-transfer engineers of the USAAF.

1. A saving of ⅔ the weight of copper in the same size and shape.
2. Heat-treatable aluminum tubes that don't break down under working temperatures as high as 275°F. instead of copper tubes that gradually anneal and weaken.
3. Heat-treatable aluminum alloy header plates, shells and other parts that stand up under much higher temperatures and pressures than other metals commonly used in heat transfer units.
4. An aluminum alloy bonding material capable of withstanding temperatures, pressures and strains several times higher than soft solder's limits.

Performance records of Clifford Feather-Weight Oil Coolers and Coolant Radiators in several types of USAAF fighters verify these advantages.

POSTWAR APPLICATIONS

Although Clifford's production is now 100% in war work, inquiries and suggestions about postwar applications of all-aluminum heat-transfer units to automotive, heating, cooling and ventilating fields will be given full consideration. *Save ⅔ the weight . . . same size and shape.* Clifford Manufacturing Co., 562 E. First St., Boston 27, Massachusetts.

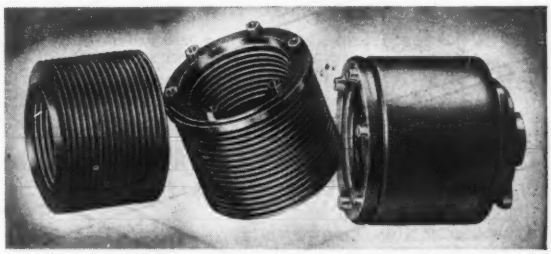
IN HYDRAULICALLY-FORMED BELLOWS

only the fittest survive

Of all the tests Hydron Bellows must pass before they go to work for you, the first is the most severe. That's the test of the manufacturing process that gives them shape . . . hydraulic forming.

Figure it out for yourself. Take a paper-thin metal tube. Force the walls transversely between the plates of a collapsible die *under internal hydraulic pressure amounting to several hundred pounds per square inch.* Tubes with imperfections or flaws can't take it. They are automatically rejected by the process.

That's why every Hydron Bellows is a sound metallurgical specimen . . . with no seams, tool marks or hidden flaws. And, further, that's why each Hydron Bellows has plenty of flexes left in its system when less severely tested bellows have quit on the job.



Naturally, when Clifford builds these perfect Hydron Bellows into assemblies for temperature and pressure control or for shaft seals and other exacting uses, every precaution is taken to preserve that inborn perfection.

Because the same men who produced industry's first hydraulically-formed bellows — Hydron — are still on the job, Clifford is equipped, perhaps better than anyone else, to supply you with these uniform, pretested hydraulically-formed bellows either as such or in highly-engineered bellows assemblies. *First with the Facts on Hydraulically-Formed Bellows.* Clifford Manufacturing Co., 562 E. First St., Boston 27, Massachusetts.

CLIFFORD *Feather-Weight* OIL COOLERS AND COOLANT RADIATORS

HYDRAULICALLY-FORMED BELLOWS

HYDRON Metal Bellows

"Something tells me we're not over Indiana"

If you were to ask expert opinion as to what is responsible for the rapidly expanding *range* of aircraft you would get many answers.

An aerodynamics expert would point out the increased efficiency of new airfoil designs. An engine designer probably would point with pride to modern engines. A propeller expert might show the part his specialty plays.

You probably wouldn't find anyone outside of the petroleum industry who would mention *gasoline* . . . or Ethyl fluid.

Yet the gradual stepping up of aviation gasoline from about 65 octane to 100 and upwards through new refining methods and the use of Ethyl fluid, is one of the basic reasons for greater and greater flying range.

A tank full of 100-octane gasoline weighs no more than a tank of 90 octane gasoline. It takes up no more room. Yet in combination with engines designed for high-octane fuels, the tank of 100 octane may be worth up to a tank and a quarter full of 90 octane in extra range.

What the equivalent of tankfuls of future higher antiknock gasoline will be, no one can say. But an important factor in future air-travel, whether military, commercial or private, is the rapid improvement of aviation gasoline.

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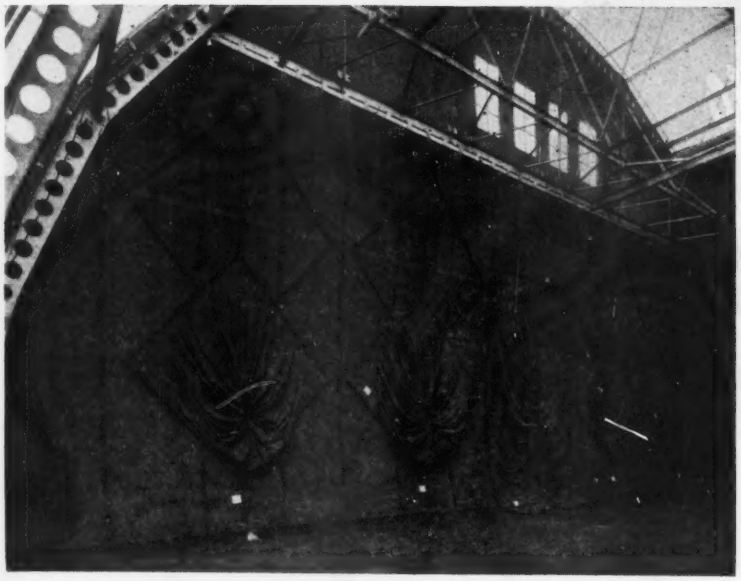


An interior view of the end curtain of a Navy portable hangar. The canvas socks are designed to provide a tight seal around a plane's engine and fuselage as they project through the curtain.

cited. *Airports*, November, 1944, pages 22, 23, 2 illus.

Portable Hangars for Navy Aircraft. A description is given of portable hangers used to protect Navy aircraft in distant outposts while they are being serviced. The canvas covering, which is supported on a steel arch, is processed to protect it from fire, mildew, and rotting and is given a special treatment to keep it flexible at temperatures as low as −40°F. *Modern Plastics*, November, 1944, pages 109, 210, 3 illus.

Airfield Building Will Pace Air Progress. Ralph S. Damon. Indicating adequate ground facilities as a determining factor in the postwar development of both air-line and private flying, the Vice-President and General Manager of American Airlines urges the institution and support of a comprehensive airport-construction program in the United States. He also comments upon the interest of the air lines in promoting private flying. He also suggests that surplus military airfields be utilized for commercial and private aviation after the war. *Airports*, November, 1944, pages 20, 43.

Local Facilities for National Progress. John H. Frederick. Stating that the usefulness of individual airports depends upon the status of other nearby airports, the writer stresses the need for improving the facilities and management standards of all airports for both air-line operation and private flying. In discussing the varying problems connected with different types of airports, he differentiates between two classes of air-line terminals and five classes of airports for nonscheduled flying. The former group includes: (1) airports having less than 30 scheduled arrivals and departures per day; (2) airports having more than 30 scheduled arrivals and departures per day. In the latter group are: (1) airports not serving a major center of population but which take care of scheduled, as well as nonscheduled, operation; (2) airports serving a great metropolis which provide exclusively for nonscheduled flying so that it and the regular air lines may be freed from the danger of one another's interference; (3) general-purpose airports for the communities having no scheduled operation; (4) subsidiary airports or airparks scattered throughout the outlying portions of a large area of high population density; (5) airparks located in recreational and other areas away from cities. *Southern Flight*, November, 1944, pages 50, 51.

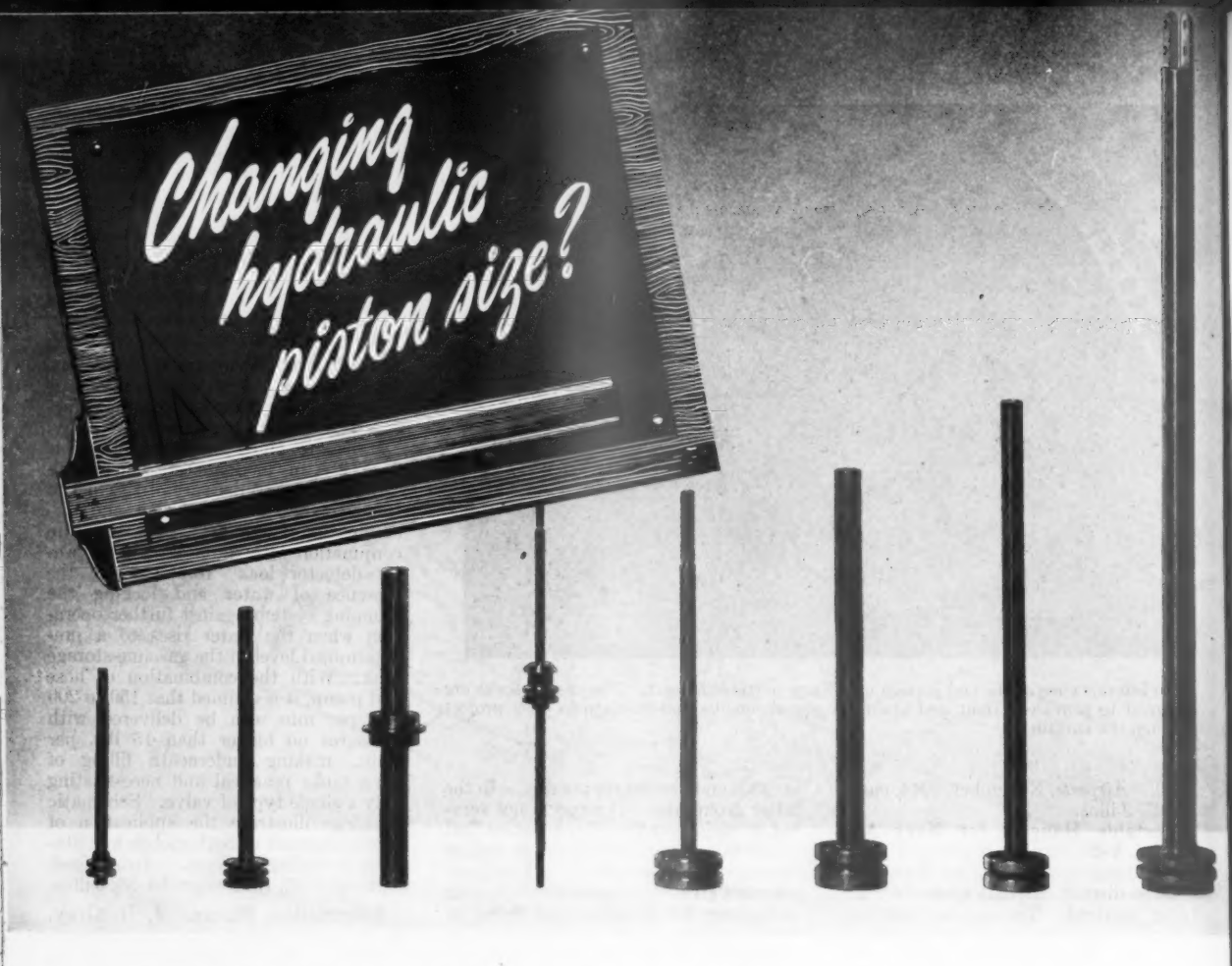
Proper Drainage Reduces Airport Maintenance. William C. Slee. The design of drainage systems for airports is discussed and the relationship of proper drainage to the reduction of maintenance cost is described. Recommendations are made for the economic design of various types of drainage systems which are applicable to both new airports and those where drainage has been neglected. A plan of action for the owner of an airport in the latter category is outlined. The importance of giving proper attention to the design of the porous backfill material is emphasized. *Aviation Maintenance*, November, 1944, pages 46–49, 166, 9 illus.

So You Want to Build an Airpark? Eugene V. Fryhoff. Successive steps in the planning and construction of an airpark are traced. Prospective airpark builders are advised how to proceed with the establishment of an airport committee; selection of a site; securing a favorable vote on an airpark-bond issue; clearing the land; development of a plan for the location and expansion of facilities; development of a drainage system; grading, smoothing, and turfing; and providing for all-weather runways and taxi strips. The cost of constructing an adequate airpark with well-drained, marked turf surfaces and the necessary buildings and service equipment, is estimated at from $20,000 to $60,000. Advantages of airpark facilities and the disadvantages to a community not having them are noted. *Airports*, November, 1944, pages 16, 17, 44, 1 illus.

Fueling of Commercial Airplanes. R. J. Jauch. A description of aircraft-refueling equipment manufactured by The Wayne Pump Company. Details are given about a collapsible hose, 2½ in. in diameter, which facilitates high-speed delivery of the fuel to the airplane; a self-priming and air-eliminating "high lift" pump used in conjunction with the hose; and a "water detector lock" for detecting the presence of water and locking the pumping system against further operation when the water rises to a predetermined level in the gasoline-storage tank. With the combination of hose and pump, it is claimed that 150 to 200 gal. per min. can be delivered with pressures no higher than 15 lbs. per sq.in., making underneath filling of wing tanks practical and necessitating only a single type of valve. Schematic drawings illustrate the application of this equipment in both mobile and stationery fueling systems. *Aero Digest*, November 15, 1944, pages 84–86, 6 illus.

Information, Please. J. H. Gray. A discussion of several questions pertinent to the operation, ownership, and management of airports. Opinions are those of the Manager of the Municipal Airport at Atlanta, Ga. The set of questions consist of the following: (1) Will an airport be self-sustaining? (2) Should airports be publicly or privately owned? (3) Should airports be publicly or privately operated? (4) What structures should be set up within a community governing body for operating its airport? (5) What type of individual should be selected as an airport manager? (6) What salary should an airport manager receive? (7) What authority should be delegated to the airport manager? (8) Should the relationship between a community and its airport manager be on a contract basis? (9) What is the meaning of the term "nonexclusive" operation? *Southern Flight*, November, 1944, pages 62, 64.

Soil-Cement Paving Costs Reduced by Use of Clay Marl. Lt. Comdr. C. B. Friday. Details are given about the use of clay marl for soil-cement paving operations in connection with a large air base in Florida. Through this construction the cement requirements were reduced appreciably and a substantial saving in construction costs was effected. Elimination of side forms when constructing individual lanes was made possible by minor modifications of the accepted procedure in paving. The practice of starting operations in the early morning hours, in addition to careful control of the moisture content of the soil cement, in-



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cluding application of a light seal coat were important factors in constructing a strong pavement at a rapid rate. Tables give an analysis of the soil and a list of the equipment used. *Engineering News-Record*, November 30, 1944, pages 67–70, 9 illus.

How Los Angeles Selected an Airport Director. The procedures of the City of Los Angeles in selecting an airport director by competitive examination are related. Open to applicants throughout the nation, the examination included a written test, evaluation of education and experience, and evaluation of personal qualifications. Relative credits accorded to each of these three elements were 50, 20, and 30. The article contains information about the type of written test given, the men who composed the board handling the personal qualification, how the examination was announced, requirements for candidates, and the scope of the examination. *Airports*, October, 1944, pages 23, 32.

Airports for the West. Part IV. Fourth article in a series investigating the requirements for postwar airport facilities in the western part of the United States and discussing some of the problems involved in the establishment of those facilities. Part IV considers the question of locating major air-line terminals where they are easily accessible in busy and large cities. Two possible solutions are offered to this problem: one, the construction of an auxiliary surface-transportation system designed primarily to serve the airport; the other, the construction of the airport itself close to the center of the city where it can be served by existing transit systems. As a possibility for the latter solution, a "mid-town" airport design for Los Angeles is described. This design is based upon the idea of flight-strips elevated about 45 ft. above the ground level and about half that height above a planned elevated highway. *Western Flying*, November, 1944, pages 64, 66, 3 illus.

Put It on a Business Basis. J. Kirk Baldwin. In this discussion of how to increase the profit possibilities in an airport operation, items are reviewed which have proved to be revenue-producing at various airports. Besides a hotel, a garage, a shopping center, and facilities for warehousing, delivery service, etc., other projects mentioned are restaurants; parking areas; telephone booths and telegraph offices; baggage lockers; vending machines for candy, cigarettes, and soft drinks; amusement facilities; barber shops; and beauty parlors. The possibilities of charges for the following conveniences are also indicated: use of the airport area by the fixed-base operator; spectator ramps; metering of electric power for the various companies and concessions on the airport; use of floodlights or runway contact lights by private airplanes; and parking space required for airplanes tied down outside hangars. It is suggested that building sites be leased for the construction of hangars, buildings, shops, etc.; that arrangements be made on a concession basis with local taxi and drayage firms for the transportation of persons and property to and from the airport; that commissions might be charged for sightseeing flights made from the airport; and that taxation under a municipal system on items such as gasoline, oil, etc., would help defray operating costs. Methods of licensing the concessions and the value of establishing sanitation standards for them are noted.

The article also includes advice about the responsibility of the community and the municipal leaders toward the airport and its operation, the desirability of short leases, cooperation with other airports, planning the annual airport budget, and an accounting system for the airport. With regard to accounting, it is stated that the ideal situation would be for all airports, both municipal and commercial, to use a uniform system. *Airports*, October, 1944, pages 20, 21, 40–42, 1 illus.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

Snow Doesn't Ground RCAF. Information is given about methods and equipment used by the Royal Canadian Air Force to keep its aircraft in operation during winter weather conditions. Two general techniques are reported to be followed: in heavy snowfall areas, the snow is compacted by rolling each fall of snow into the previous layer; in light precipitation areas, snow is removed entirely. Procedures noted include those of snow removal, compacting of snow by rolling and dragging, and compacting of wet snow by a method using cocoanut matting and a salt solution. *Aviation*, November, 1944, pages 164, 165, 293, 295, 5 illus.

Airfields for the Invasion of Italy. Col. J. O. Colonna. The construction of airfields in Italy after Sicily was taken is described. It is explained that airfields on the mainland were essential because Spitfires operating from Sicily could stay over the Salerno battlefield only 15 min. Aviation engineers made reconnaissance on D-day and moved equipment in during the night. On the day after the invasion they built a 4,500-ft. runway, and at daylight on the second day fighters landed. Other airports were built just behind the moving front as it advanced to Naples, Rome, and beyond. Operation experience is recounted on dirt, grass, volcanic ash, and pierced-plank and permanent runway surfaces. *Engineering News-Record*, November 2, 1944, pages 82–85, 3 illus.

Airport Merchandising. Dudley M. Steele. Some comments are made on the revenue-producing value of hotels at air terminals. Besides the writer's own observations ideas are quoted from a speech made by Kirk Baldwin at the Southeastern Regional Airport Management Conference in Auburn, Ala. Other general service facilities that can be installed at an airport are also suggested. *Southern Flight*, November, 1944, page 47.

How to Maintain Lighting Equipment. Ingram Jones. Procedures suggested for the servicing of airport lighting systems are listed. With the checkups scheduled at 4-week intervals, maintenance routines are outlined for the following equipment: rotating beacons, control devices, wind cone, obstruction lights, cone-mounted lights, control and distribution cabinets, and flush-type lights. A schedule of major servicing at 12-week periods is also given for all the equipment but the control and distribution cabinets. *Airports*, October, 1944, pages 30, 31, 2 illus.

How to Winterize Airport Field Lights. Five ways to prevent airport marker lights from being broken by snow-plow operations are listed in this article. A chart is shown of methods of installing and conserving airport lights. *Aviation Maintenance*, November, 1944, pages 70–82, 12 illus.

Armament

Bombs Away! Brig. Gen. R. C. Coupland. Information is given about how the organization of the Air Ordnance office handles, in whole or in part, all the various functions of ordnance for the Air Forces. It is noted that the first Ordnance service in the Air Forces was established by Major Gen. Russell L. Maxwell almost 10 years ago. The expansion of Aviation Ordnance is described. Problems connected with the procurement and supply of bombs for the Air Forces are discussed. Figures are given on the increased use of bombs resulting from the intensification of bombing activities. *Army Ordnance*, November-December, 1944, pages 444–446, 2 illus.

Avigation

Groundwork for a New Interpretation of the Problem of Air Navigation. Part IV. Tappan Collins. The fourth of a series explaining the principles and operation of a proposed system of navigation called "Flight Kinemetrics" emphasizes the advantages of single-instrument indication. In further explaining the scales of the instrument, the writer defines the great circle, of which some arc is to be used as the reference, and describes the setting of the instrument to the selected great circle of reference. Details are given concerning the arrangement of the instrument and its operation. No suggestion is made regarding the mecha-

nisms required to actuate the proposed indicating instrument, but it is stated that the problem is capable of solution with no greater difficulty than those solved in other instruments. *Aero Digest*, November 1, 1944, pages 58, 59, 133, 4 illus.

Business and Finance

Parks Plane-Buying Plan Combines Time Payments, Insurance. A report of a combined time-payment and insurance plan for the purchase of personal aircraft which has been put into operation by an airplane sales organization in conjunction with a bank and an insurance company. Under this plan, the purchaser may select any of three types of policies—limited hull coverage, named-peril coverage, and comprehensive hull coverage—and the policy may cover flight activities of several individuals. As outlined, the procedure on financing is as follows: The delivered selling price of airplan and accessories (if any), the tax, and the cost of the selected insurance are totaled for the basic time price. The down payment (33⅓ per cent on new airplanes and 40 per cent on planes over 6 months old) is calculated and subtracted from the basic time price to determine the net amount to be financed. Then, from standard charts, the total contract amount is established, together with the amount of monthly payments according to length of the contract. *Aviation*, November, 1944, page 185, 1 illus.

Financing of Aircraft Sales. Stewart Linder. For the benefit of local banks and other organizations that wish to participate in this type of financing, advice is given regarding loans for the purchase of aircraft. Special problems that have to be dealt with in financing for private owners, distributors and dealers, repairs, and student instruction are noted. Insurance protection necessary for the risks are outlined, while attention is called to Aero Insurance Underwriters service for assisting the financier with depreciation estimates. Approved forms for handling transactions are described, and title documents required by the C. A. A. for the ownership and transfer of aircraft are listed.

In advocating the theory that aircraft should be financed locally instead of through national finance institutions, the writer offers the following reasons: (1) a saving in financing costs; (2) a more convenient financing plan; (3) greater simplicity; and (4) broad insurance coverage provided by local insurance agents. (5) By the aircraft dealer or distributor becoming firmly established with a local banking institution, in addition to having the banks' assistance in the financing of sales and inventory, facilities would also be available for short-term or emergency advances and discounts, and at all times experienced and informed opinion would be on hand for advice on collateral business problems. *Aero Digest*, November 15, 1944, pages 80, 81, 247, 2 illus.

Official Photograph, U.S. Army Air Forces

A muzzle end view of three bazooka guns mounted on the wing struts of a Piper Cub Artillery liaison plane somewhere in France. Three launchers are attached to each wing of the plane. The guns may be fired individually or in salvo.

Preview of Coming Airline Financing. Raymond L. Hoadley. A discussion of methods that will probably be employed by the airlines to finance their purchase of postwar planes. As a result of accumulated earnings plus conservative dividend policies, it is predicted that the air lines will be in a position to float fewer stock issues, rely more on bank credit, and not have to resort so much to the equipment-trust method used by the railroads. Definite courses of action with regard to probable methods of paying for future equipment are more particularly forecast for four air-line companies: American Airlines, Eastern Air Lines, United Airlines, and T.W.A. *Aviation*, November, 1944, pages 192, 296, 297.

Camouflage

Camouflage. Michael Goodwin. This article deals with British methods of camouflaging airfields. A comparison is made between the problem presented by the airdrome in Britain and that of the emergency landing strips and mobile landing grounds employed by the British Second Tactical Air Force in France. In the case of the landing facilities in France, it is told how the camoufleurs provided for the concealment of all arms and personnel in a mobile unit. Where emergency airdromes or strips were concerned, they recommended that runways should be built out of existing road features, the roads being extended and widened to meet the necessary requirements; that the facilities for housing personnel be located close to, or beneath, natural cover and intelligently dispersed, with entrance and exit on the existing path or roads; that a strict track plan be followed; and that a drainage system be dug so that it would not cut conspicuously across, but rather fit in with, the natural ground pattern. *The Aeroplane*, October 6, 1944, pages 387, 388, 2 illus.

Civil Aviation

Tennessee Bureau Leads the Way. W. Percy McDonald. The accomplishments of the Tennessee Bureau of Aeronautics in furthering aviation in that State are reviewed by its Chairman. In the summary of developments that have been sponsored, much of the emphasis is seen to have been on aviation education and training. The review takes into consideration various ways by which the teaching of aeronautics has been incorporated into the general school system; the establishment of aviation ground schools; plans for establishing at the University of Tennessee an airport managers' school leading to a degree or certificate in airport management; an increase in the number of airports; contributions to the aviation phase of the war effort; the work of the Civil Air Patrol; establishment of college airports; a program for training glider pilots; the training of women pilots; the distribution of educational books on aviation; a program for aviation indoctrination of high-school teachers; the institution of an Airport Development Laboratory and an Airport Instrument Laboratory; and the furnishing of engineering and architectural services for airport construction. The cost of the operating of the Bureau and methods of obtaining funds are also noted. *Southern Flight*, November, 1944, pages 48, 49, 74, 2 illus.

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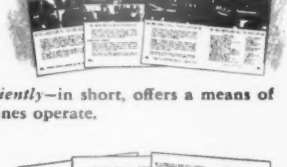

Leaf through these pages to find how "Air at Work" steps up efficiency of plants and processes. Typical examples show how air handling equipment that's properly engineered and installed purifies the air, heats or cools it, makes it wet or dry, conveys, removes fog, fume or dust; burns coal, oil and gas *more efficiently*—in short, offers a means of mastering competition wherever men and machines operate.

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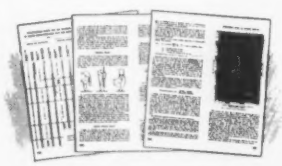

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Mexico Offers Flyers Thin Air... and Opportunities. Juan Nolan. Indicating the economic possibilities of aviation in Mexico and establishing the fact that the airplane is more logically adapted to the needs and conditions of the country than any other means of transportation, the writer pleads the cause of better aviation facilities for Mexico. He shows the urgent need for equipment, service, and landing fields, with particular emphasis on the potentials of private flying if the inadequate supply of those three things could be remedied. Climatic and topographic characteristics of Mexico are discussed, as well as the high-altitude conditions that for the main part prevail throughout the country. In addition, some data are given on the progress and status of Mexican military and commercial aviation. These details include reference to organization, government regulation, training, and licensing. *Aviation*, November, 1944, pages 182–184, 276, 279, 280, 284, 285, 287, 6 illus.

The Private Airplane. The past and future of private flying and the private plane are analyzed. Reasons why private flying falls short of being a major factor in the industry are discussed. Reference is made to certain past articles that represent sound thinking on problems of private flying and the postwar outlook. Conditions that have restricted private flying are outlined. *U. S. Air Services*, November, 1944, pages 20, 22, 52.

Companies

UAL...Line of the "Flying Lab." Victor Boesen. This is an outline history of United Air Lines Transport Corporation. The development of the company is traced from 1918 through the evolution of its five predecessor companies (Varney Air Lines, National Air Transport, Boeing Air Transport, Pacific Air Transport, and Stout Air Lines) into United Air Lines and through events that highlighted its progress from 1931 to the present time. Besides the air line's past achievements, notes are included about its present operations, its future plans, its services, and its equipment. Among the "firsts" with which United Air Lines is credited are: the first successful streamlined air transport, the first stewardess, the first air-line commissary, and the first two-way radio for an air liner. It is also said to have pioneered in the perfecting of blind landings and in ridding transports of static built up in flight. *Skyways*, December, 1944, pages 32, 33, 78, 80, 82, 7 illus.

Control Equipment

Solenoid-Operated Hydraulic Valves for Aircraft Applications. George A. Goepfrich. Reference is made to a tendency on the part of some manufacturers during the last few years toward the elimination of hydraulic controls on combat planes. It is stated that the vulnerability of hydraulic systems used on airplanes manufactured during that period is to a certain extent responsible for the trend. It is shown that the changeover has been slow because hydraulically operated controls have a number of advantages over other types in applications where considerable work must be done during a short period of time. Steps taken to overcome the shortcomings of hydraulic systems for combat planes are outlined. Developments include improved packings for low-temperature operation, hydraulic fuses that isolate any portion of a hydraulic system which has a ruptured hydraulic line, and lightweight solenoid-operated control valves. The major advantages of solenoid-operated valves are listed, and the design of these valves is described in detail. *Electrical Engineering*, November, 1944, pages 866–868 (Transactions), 5 illus.

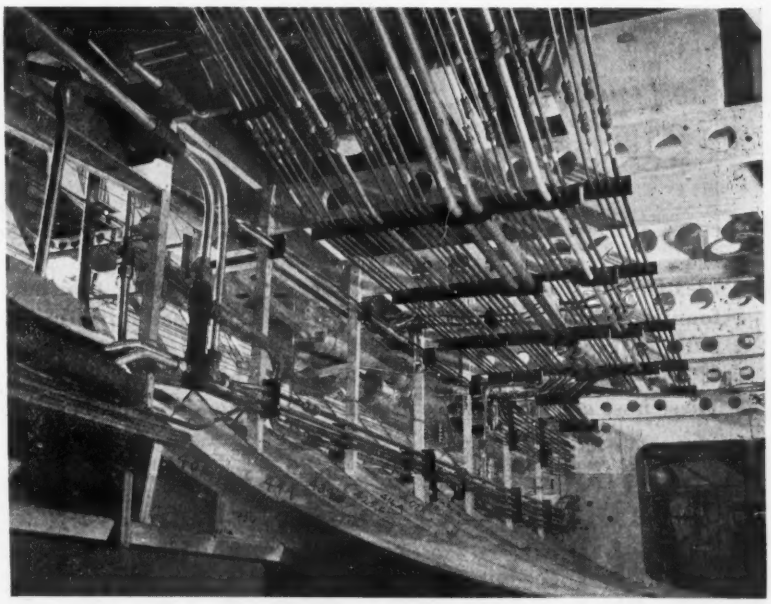
Electronics Sets Standard for Automatic Control. W. H. Gille and R. J. Kutzler. Automatic flight control is discussed with particular attention to the application of electronic control principles that have made it possible to achieve full flexibility of control with completely automatic operation of all control functions. Some of the complications involved in automatic flight control are outlined. It is pointed out that in turning maneuvers the automatic pilot must accurately proportion the movement of each control to fit a complex pattern and, at the same time, coordinate the movement of all controls to maintain them in proper relationship with one another. To be universally adaptable, the automatic pilot must have provisions for easily adjusting its operating characteristics to match those of different types of airplanes. How the use of vacuum-tube circuits simplifies the solution of these problems and also makes possible a degree of sensitivity and accuracy not obtainable by other means is described. *Machine Design*, November, 1944, pages 117–122, 12 illus.

German Pressure Control Units. This article is based on a report of the Committee on Non-Ferrous Parts of Enemy Aircraft. It covers the results of an investigation of various control units taken from German aircraft. Information is given about the materials and constructional features of pressure-control units. *Aircraft Engineering*, October, 1944, pages 302, 303, 4 illus.

Design

Design Analysis of the B-24J "Liberator." F. W. Fink. Constructional and design features of the B-24J Liberator are analyzed. Detailed descriptions are given of the structural features of the wing, tail surfaces, and fuselage, with tabulated specifications of various components. The engines, propellers, hydraulic system, control equipment, instruments, and accessories are similarly treated. Among the illustrations shown are an exploded view of the plane, a cutaway drawing illustrating the principal structural features, and detailed drawings of various components of the bomber. Particular attention is given to the design of the wings, tail surfaces, and fuselage. Some of the important specifications of the bomber are listed. *Industrial Aviation*, November, 1944, pages 15, 16, 18, 24, 26, 27, 29, 30, 22 illus.

Center of Gravity Location. Norman N. Rubin. The position of the center of gravity in an airplane is examined as a factor in the determination of airplane range and the reduction of fuel consumption for long flights. How the drag is affected by the move-



This Lockheed Constellation cargo-compartment mock-up shows the care used in designing and installing hydraulic lines and their connections for ease in servicing and maintenance.

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ment of the center of gravity is explained by an example and illustrated by sketches. The effects of speed are also considered. It is found that a difference does exist in the drag for various center-of-gravity positions, but the difference is so small that it is barely discernible on the pilot's air-speed indicator. It is concluded that the discrepancies between calculated and achieved ranges or fuel consumptions must be accounted for on some other basis than that of center-of-gravity position. *Aero Digest*, November 1, 1944, pages 83, 226, 3 illus.

The Douglas C-54. Charles J. Hawkings. Design features of the Douglas C-54 combat transport plane are analyzed and illustrated pictorially and diagrammatically. An exploded view of the plane is shown. Diagrams disclose the details of the hydraulic and fuel systems. Photographs of the instrument panel show the layout of the instruments. *Air Tech*, December, 1944, pages 17–25, 12 illus.

Designed Utilization...It Points to Profits. Part I. Scholar Bangs. The first of two articles discusses the engineering technique evolved by Lockheed Aircraft Corporation for the purpose of increasing potential utilization of a commercial airplane. The method is called "Designed Utilization," its purpose being to design large transport airplanes in such a way that the maximum possible utilization may be achieved. The ideal of 24 hours per day of operation of a commercial airplane is approached to the extent that the proposed design is stated to enable the utilization of 18 hours per day. The objective is defined as a consideration of all factors in the initial design which will contribute to the maximum utilization of the plane, and the 18-hour figure is set on the basis that it should not be necessary to keep an airplane on the ground longer than 6 hours per day for service and maintenance. The writer quotes seven basic factors to establish the utilization potential: (1) location of all installations for maximum accessibility; (2) grouping of associated installations in access areas; (3) interchangeability of parts; (4) accessibility of maintenance areas; (5) development of special service and maintenance procedure; (6) special tools for service and maintenance; (7) training ground personnel who will supervise maintenance of the airplane following delivery to the buyer.

Time studies are described and formulas are suggested by which these design objectives are to be achieved. Particular attention is given to placing of access panels, making it possible to reach the various parts of the airplane in the shortest time and with the least work. *Air Transport*, November, 1944, pages 24–33, 22 illus.

Basic Arrangement of the Modern Private Airplane. Richard G. Naugle. First half of a two-part article discussing the requirements of a postwar "automobile of the air" and the type of airplane which will fulfill those requirements. In Part I the basic considerations for the design arrangement of a private plane that will transport four people are investigated. The immediate design problems are outlined as the need for streamlining the fuselage for lowest drag and best vision; determining the best center-of-gravity location; locating and determining the type of wing; arranging the landing gear in relation to the center of gravity; and determining the logical engine location. Examination of each of these factors evolves the possibility of various so-called unconventional designs, including a "tail-first" or Canard type aircraft for the postwar family airplane. Advantages of these types of plane are indicated. *Western Flying*, November, 1944, pages 48–50, 94, 100, 3 illus.

Design Features of the "Ercoupe." A detailed description is given of the design characteristics of the Ercoupe Model 415-C, a two-place, low-wing monoplane of metal construction designed and manufactured by Engineering and Research Corporation. The form and materials of the various parts of the fuselage are described at length, and details are given about the engine and its mounting and the control mechanisms.

The "spinproof" characteristics are attributed to features of the basic design which are stated to be such that the plane will not balance in flight at a high enough angle of attack to allow the wings to stall. The writer analyzes aerodynamic characteristics involved in this feature of the design. Sketches show various details of construction. *Aero Digest*, November 1, 1944, pages 84–87, 6 illus.

Electrical Equipment

Paralleling and Regulation of 24–28-Volt D-C Generators in Multiengine Aircraft. Arthur Siegal and Dennis G. DeCourcey. The findings of a rather extensive program of testing electric systems in aircraft are presented. The writers describe the electric system now being used in most Army Air Forces multiengined aircraft and a proposed system that has been developed as a result of the tests. The system differs from the present one primarily in that it employs separate networks for power feed and distribution instead of a common bus. Several desirable features of such a system are discussed. *Electrical Engineering*, November, 1944, pages 854–857 (Transactions), 5 illus.

Application of Electronics to Aircraft Flight Control. W. H. Gille and R. J. Kutzler. As a typical example of equipment in which the use of electronic devices has produced a flexible and well-coordinated control system, the type C-1 Autopilot used in heavy bombardment aircraft is described. Information is given about the bridge circuits interconnecting the gryoscopes, the servo units, and the amplifier. In the summary of conclusions it is predicted that continued development of electronic controls will produce a small, lightweight, foolproof automatic pilot for peacetime use. *Electrical Engineering*, November, 1944, pages 849–853 (Transactions), 15 illus.

Higher-Voltage D-C Aircraft Electric Systems. W. L. Berry and J. P. Dallas. The advantages of 115-volt d.c. aircraft electric power are presented, with frequent comparisons with 24-volt direct current and 208/120-volt, 400-cycle three-phase alternating current. System reliability is emphasized. Weight comparisons favorable to 155-volt direct current are shown for power generation, distribution, and load components. Problems concerning the use of the two high-voltage systems are discussed and compared. The writers discount the popular belief that 115-volt d.c. switching and commutation is unsatisfactory at high altitudes. It is concluded that 115-volt direct current is the lightest and most practical of the proposed electric systems for both medium and large airplanes. *Electrical Engineering*, November, 1944, pages 843–849 (Transactions), 4 illus.

Carbon-Pile Voltage Regulators for Aircraft. W. G. Neild. It is noted that an appreciable saving in weight can be accomplished by designing aircraft generators with high field currents. The trend toward such lightweight generators called for the development of a high field-current voltage regulator. This requirement was met by adapting to aircraft the art of carbon-pile regulation extensively used in railroad lighting equipment. This paper is devoted more particularly to an explanation of the principle on which the carbon-pile regulator operates and to a discussion of the advantages and disadvantages of the regulator. The general design features of the regulators are also described. *Electrical Engineering*, November, 1944, pages 839–843 (Transactions), 13 illus.

Brief Survey of Power-Supply Developments on British Aircraft. P. W. Carter. A chronologic outline is given of the development of electric generating equipment and systems on British aircraft from the 1920's up to the present time. The article deals particularly with the d.c. power supply and with the power supply for radio and radar equipment. *Electrical Engineering*, November, 1944, pages 806, 807 (Transactions).

Requirements for Low-Voltage Aircraft Cable. R. E. Hedges. The basic requirements for electric cable used in aircraft are given. Some of the problems encountered in forming a cable specification are described, as well as the factors to be considered in establishing valid test procedures. The writer's object is not to give solutions to the problems but to acquaint the reader with the fact that a major prob-

lem does exist in designing an electric cable suitable for use in aircraft, and that many factors that are extremely variable must be considered before an adequate solution can be found. Some of these factors are outlined. *Electrical Engineering*, November, 1944, pages 808–810 (Transactions).

Aircraft Electric Systems. Part II. R. J. Sutton and G. C. Close. The second section of a continued article discusses electric motors as used in aircraft, their functions and characteristics. A table lists 26 possible applications of electric motors for operating pumps, valves, tabs, flaps, blowers, instruments, landing gear, and numerous other controls, and examples of these uses are given. Direct-current motors are classified according to winding, duty cycles, and method of construction, with information about the work for which the different types are suitable and the advantages of each. Formulas developed by the Army Air Forces for calculating the weight and efficiency characteristics of a.c. and d.c. motors are reproduced, with comments about the duties for which a.c. motors are advised. Suggestions are made for the provision of adequate cooling, and the limitations imposed on the speed and weight of motors are outlined. The operation of slip clutches and magnetic clutches is explained, and the possibilities of electronically controlled motor devices are explored. *Western Flying*, November, 1944, pages 70, 72, 74, 76, 100, 4 illus.

Requirements for Aircraft Electric Motors. E. R. Siefkin. The design requirements for electric motors for aircraft are classified. The manner in which these requirements are established and the specific reasons for some of the requirements are outlined. The article has particular reference to 24-volt d.c. motor applications. *Electrical Engineering*, November, 1944, pages 810–813 (Transactions), 1 illus.

Functional Design of Aircraft Electric Actuator Equipment. C. E. Gagnier. Factors that influence the design of an electric actuator are listed in the order of their importance. Points that must be considered by the designer of electric actuating equipment in formulating such a design are also given. Methods are suggested for obtaining solutions to many of the problems involved. It is noted that the design of equipment of this nature will be found to be about one-fourth electrical engineering and three-fourths mechanical engineering and should only be attempted by an engineer or group of engineers with broad training and experience in both fields. It is shown that a great effort must be made by the designer of the electric aircraft actuator to cut the weight to an absolute minimum consistent with the stated requirements. It is stated that this is accomplished by ingenious design, by the proper selection of equipment, by the rigid control of process, and by insistence upon high standards of workmanship. *Electrical Engineering*, November, 1944, pages 813–815 (Transactions).

A 40-Kva 400-Cycle Aircraft Alternator. H. E. Kenieppp and C. G. Veinott. It is noted that there are indications of a revival of interest in a.c. auxiliary power systems for aircraft. The a.c. generator especially designed and built for 208-volt, three-phase systems is described. The writers tell about the problems that had to be met in designing this lightweight generator.

Sections of the paper deal with the generator-mounting arrangement; method of excitation; stator, rotor, and exciter construction; and mechanical design considerations. It is concluded that tests have demonstrated that 40-kva., 400-cycle a.c. generators are ready for use in aircraft as soon as a constant-speed drive or other suitable driving means is made available. A weight of 85 lbs. for this 40-kva. a.c. generator compared with a weight of 47 lbs. for a 9-kw. d.c. aircraft generator indicates that electrical output of generators still can be expected to increase faster than the weights. It is stated that the limit of rating of aircraft generators is not within sight and that in the future direct-connected alternators may be used to maintain aircraft engines in synchronism. *Electrical En-*

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Test engineer's observation post outside an individual engine test cell, showing the Fairbanks-Morse Scale and the gauges which indicate engine performance.

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Scales

gineering, November, 1944, pages 816–821 (Transactions), 14 illus.

Aircraft Electrical Horizons. Frank W. Godsey, Jr., William L. Berry, and T. B. Holliday. In this paper, written for designers of electrical equipment for aircraft, the writers suggest that some goals are within reach at present and that further progress will then be made. The needs for continued improvement are outlined as incentives for engineers. The units in which opportunities are found for betterment are: generators and motors, communications equipment, aircraft lighting, inverter power supplies, relays and switching devices, load and equipment considerations, and power-distribution systems. Comparisons are made of a.c., d.c., and hydraulic systems of control, and other tasks for electrical devices are discussed. The prospects for electric drives for aircraft are explored. *Electrical Engineering*, November, 1944, pages 821–924 (Transactions).

High-Altitude Brush Problem. D. Ramadanoff and S. W. Glass. Reference is made to the rapid wear that was found to occur in the brushes for motors and generators of military aircraft under the conditions of high-altitude flying. Tests conducted in the laboratory of the National Carbon Company to determine the cause of the rapid brush wear encountered in actual flights are described. For the study of the operating properties of carbon brushes at reduced pressures and in various atmospheres, two vacuum chambers were used. The construction of these chambers is briefly reviewed. Information is given about the effects of oxygen, water vapor, and temperature in the coefficient of friction and wear of brushes. Results are tabulated. *Electrical Engineering*, November, 1944, pages 825–829 (Transactions), 10 illus.

Aircraft Storage Battery Design. John L. Rupp. The writer explains how storage-battery requirements for aircraft are different from battery requirements for other services. A step-by-step description is given of the important parts of the aircraft battery and of how each part has been designed to meet particular performance requirements. The occurrence of departures from what may be considered sound practice is noted, and reasons are given for such variations. Methods for correcting these departures are suggested. The data and experience accumulated are summarized, and a design is suggested for overcoming present aircraft-battery deficiencies and for meeting present requirements. *Electrical Engineering*, November, 1944, pages 773–777 (Transactions), 14 illus.

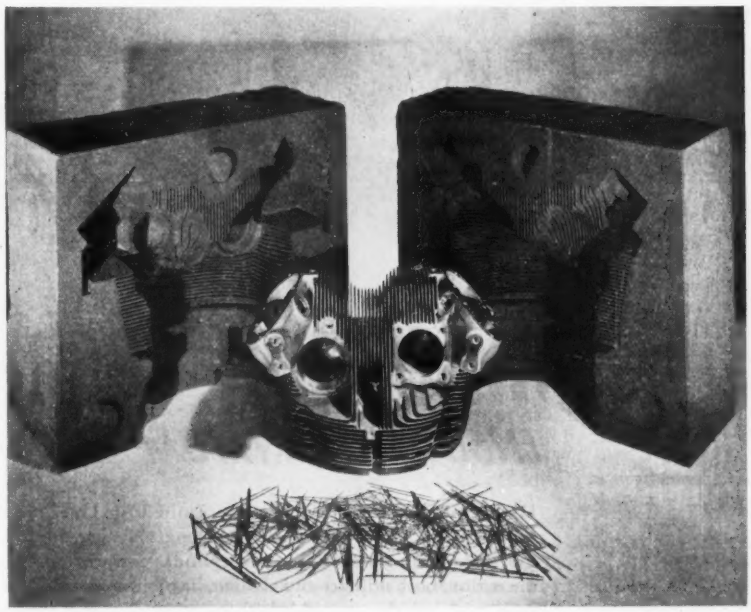
Electric Gun Turrets for Aircraft. J. D. Thompson. A survey is made of the different types of electric-drive equipment for aircraft gun turrets. The article describes the types and variety of equipment now in use and how this equipment operates. Following a general description of gun turrets, information is given about power-drive requirements and types of drive equipment. Details are given about the Amplidyne turret drive and control equipment. *Electrical Engineering*, November, 1944, pages 799–801 (Transactions), 8 illus.

Engines

Complete Power Units. Some brief notes on the development of complete power plants by the Bristol Aeroplane Company, Ltd. It is reported that in addition to the widely used Bristol Hercules unit, the Centaurus radial engine, newest of the Bristol engines, is already installed in complete interchangeable power-plant form in a certain large type of flying boat, although secrecy regulations prevent the publication of any detailed information. The latest Hercules power plant is said to be standardized to include the following equipment in addition to the engine itself: engine mounting; bulkhead and fittings; engine cowling; controllable cooling gills, with electric driving motor; intercylinder baffles, etc.; nacelle shoulder cowling and supports; fire-extinguishing system; fuel system, including filter; oil pipes; exhaust system, complete with flame-damping and cabin-heating equipment; engine-control system; electric starter, with hand-turning gear attachment; miscellaneous electrical equipment, including tachometer, etc.; carburetor air intake with bypassable air cleaner. To suit particular aircraft requirements the following are added to the standard Hercules power plant: engine-driven gear box for aircraft; aircraft accessories fitted to gear box; oil cooler nacelle and fairing panels; and propeller controls. *Flight*, October 5, 1944, page 372, 1 illus.

The Gipsyqueen II. J. A. Oates. Second of a series of articles reviewing the methods employed for the manufacture of the de Havilland Gipsyqueen II. Part II deals with the subcontracted fabrication to de Havilland design of two specialized components: the pistons, which are made by Specialloid, Ltd., and the crankshaft, which is built by English Steel Corporation, Ltd. It also contains a description of how the de Havilland company machines the connecting rods. Particulars of each contributing operation are given in detail, and information is included about the equipment used in each process. *Aircraft Production*, November, 1944, pages 513–527, 43 illus.

An Investigation of Chafing on Aircraft-Engine Parts. H. C. Gray and R. W. Jenny. A report of an investigation conducted for the purpose of evaluating various chafing-prevention methods and obtaining more knowledge about the mechanics of chafing. It is noted that chafing, galling, or fretting corrosion is a phenomenon that has become more important in aircraft-engine parts as the power output has increased. The deflection of parts designed for minimum weight increases the tendency of clamped or pressed surfaces to move slightly relative to each other, especially under increasing loads. This motion causes chafing, which introduces stress con-



Production of sand molds used in casting aluminum cylinder heads has been increased 330 per cent through improvements in the positions of risers and other details developed by Chrysler Corporation production executives and engineers at the Dodge Chicago plant. These heads are for the 2,200-hp., 18-cylinder, Wright radial air-cooled engines used to power the Boeing B-29 and other large aircraft.

Standard foundry practice normally requires the use of 750 hand-installed steel pins in each mold to prevent breaking down of the sand fins when hot metal is being poured into them. At the Dodge Chicago plant only 150 pins are used; this allows a saving of more than 36 man-hours per machine every 8 hours. In addition, the use of an improved gate and riser saves 10 lbs. of aluminum per casting.

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centration in the affected areas. A description is given of a group of laboratory tests and the apparatus used in evaluating a limited number of methods for eliminating chafing, primarily for application to aircraft-engine development. Conclusions are summarized with respect to the severity of chafing and the means for preventing it. *SAE Journal*, November, 1944, pages 511–518 (Transactions), 21 illus.

Inlines? Leonard Engel. The writer examines the possibilities of liquid-cooled, in-line engines for commercial applications after the war. It is noted that the liquid-cooled in-line engine still has a higher installed weight than any other type of aircraft power plant except the Diesel but that the weight differential between it and the air-cooled radial has been considerably narrowed. The most valuable characteristic of the in-line engine is indicated as its small frontal area and attendant reduced drag. The saving in horsepower for given performance, as compared with the air-cooled radial, is said to be sufficient to overcome the higher installation weight on long flights. In prewar European experience the "break even" point was about 600 miles.

It is concluded that because the liquid-cooled, in-line engine is as reliable as any other type, it is possible that it will be used for American commercial operations, especially for future designs of planes used for nonstop transoceanic and other flights at extreme range. *Air Tech*, December, 1944, pages 30, 31, 58, 2 illus.

Flight Operations

What About Airport Traffic Control? Capt. Maxwell W. Balfour. A consideration of some methods for preventing air-traffic congestion around postwar airports. The dual traffic pattern, the two-circle method, the use of runways for large airplanes while unpaved portions of the field are reserved for light planes, the division of the field into separate halves for take-off and landing, and dual runways are among the possible methods noted. Facilities necessary for directing traffic are listed, and radio equipment for receiving instructions inside the plane is specified. To avoid confusion on the part of the average private flier, the writer states that there should be no attempt to set up traffic patterns to fit the peculiarities of individual fields but that 99 per cent of airport operations should be based on a simple and universal left-hand traffic pattern, 1,000 ft. above the ground and about $^1/_2$ mile outside the boundaries of the airport. *Airports*, November, 1944, page 21.

Flight Technique

"...In Standard Air." Wolfgang Langewiesche. With particular reference to the light plane, this is a study of the effects of different conditions of the air upon airplane performance. Changes in altitude, barometric pressure, and temperature are considered. The pilot is advised how these changes vary the action of the plane from its performance under "standard atmosphere" conditions and what he must do to anticipate and counteract these variations. Summarized, his attention is called mainly to the fact that both altitude and heat cause thinning of the air and consequent reduction of airplane performance. He is therefore counseled to keep the airplane's load light when flying during the summer or from high airports. It is also suggested that, under those two conditions, he allow for the airplane failing to take off in the usual distance, allow for poor climb after take-off, and keep flying straight at normal climbing speed and in normal climbing attitude in case the airplane is temporarily unable to outclimb a downdraft. *Air Facts*, December, 1944, pages 38–40, 42, 44, 46–48, 50–52.

Fuels

Aviation Petrol. Parts I, II, and III. This three-part article explains how aviation-gasoline quality is related to engine performance and gives some information about the composition of aviation gasoline. Because detonation is the fuel factor that more than any other tends to limit engine output, this subject is discussed in Part I. Sections deal with the cause of detonation, octane number and its measurement, tests for determining the antiknock value of gasoline, the relation between antiknock value and engine performance, and antiknock substances. The effects of the volatility of the fuel and of vapor lock on engine performance are also discussed.

In Part II the discussion of fuel volatility and vapor lock is continued. Consideration is given to mixture distribution, carburetor icing, oil dilution, and the evaporation of fuel fractions in storage. The causes of deposits in the combustion chamber and crankcase, as well as corrosion, are also discussed.

In Part III a brief outline is given of the hydrocarbons that form the ultimate constituents of aviation gasoline. The writer then describes the components used in blending aviation gasoline. *The Aeroplane*, October 13, 1944, pages 422–425, 10 illus.; October 20, 1944, pages 443, 444, 1 illus.; October 27, 1944, pages 471, 472, 1 illus.

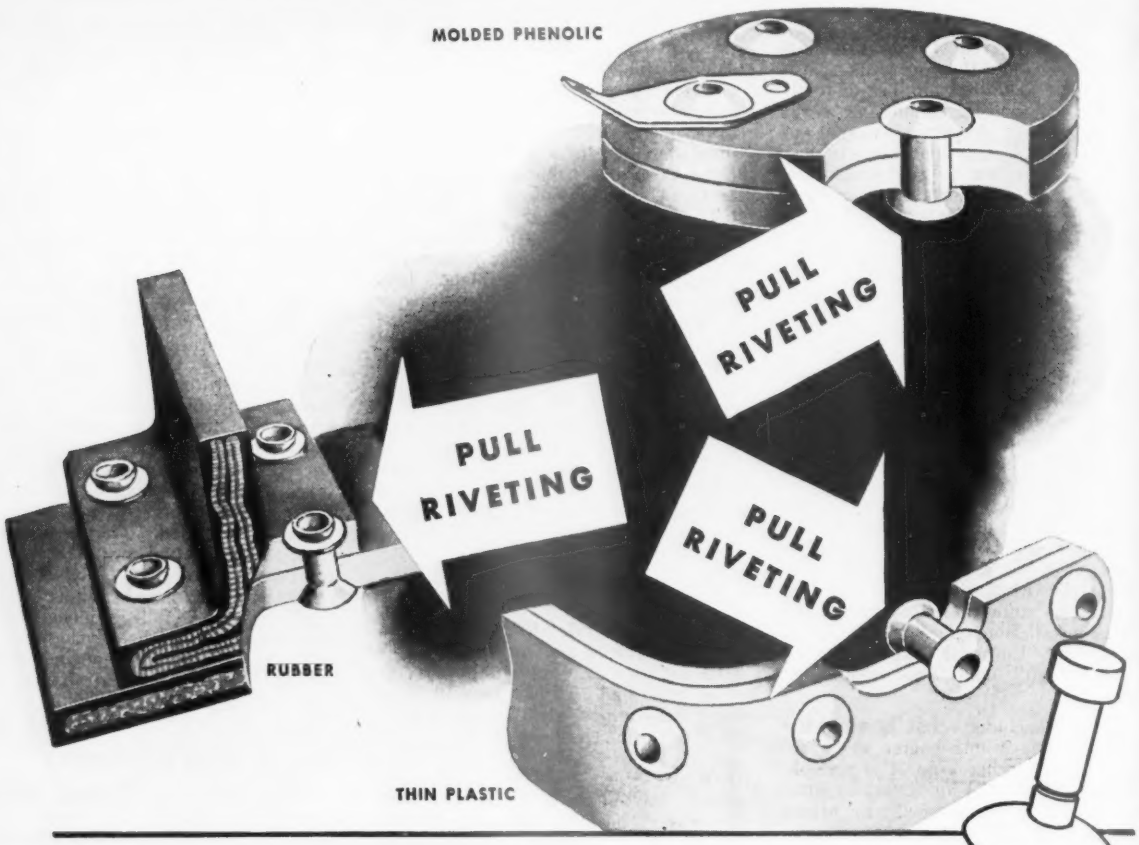
Aviation Fuel and Engine Performance. W. J. Sweeney. The writer explains, in language intended to be understandable to the laymen, how the phenomenon of detonation or knocking imposes limits on the performance and range of aircraft. Noting that there is need for more full-scale engine test data, he states that further improvement in fuel quality may come through better knowledge of the great number of different hydrocarbons found in petroleum or that it may come through better engine design. In explaining the cause of knocking, he traces the sequence of events that take place in the cylinder when a compressed mixture of gasoline and air is ignited and discusses the effects of fuel quality on economy and performance. With the aid of tables and simplified curves, the relationship of the fuel to the power delivered is described, and fuels of different characteristics are compared. Consideration is also given to methods of adjusting carburetors to meet operating conditions and to the evaluation of fuel quality. *Western Flying*, November, 1944, pages 44, 45, 90, 92, 4 illus.

Why Engines Knock. W. J. Sweeney. After pointing out that the chief limiting factor in aircraft-fuel performance is the tendency of most petroleum hydrocarbons to knock under increased power conditions, the writer proceeds to discuss the cause of detonation and its effect on engine performance. An explanation is given of what takes place when knocking occurs and why enriching the mixture tends to prevent detonation. The thermal efficiency of an actual aircraft engine is compared with that of a theoretic engine with maximum heat losses. How research with a full-scale engine test stand is aiding in the development of better fuels for gasoline engines is described. *Scientific American*, December, 1944, pages 262–264, 3 illus.

Gliding and Soaring

The Future of Soaring Flight. Terence Horsley. Problems connected with the creation of an active soaring-flight movement in England after the war are discussed. Consideration is given to the relative advantages of soaring in gliders and of flying in light airplanes. Figures are included to illustrate the economy of soaring: the cost of club subscriptions, instructional flights, soaring in club aircraft, accommodations in bunk house, and meals. The technique of glider flying is discussed, and the specifications of a typical modern glider are listed. *Aeronautics*, November, 1944, pages 34, 35.

Power for Gliders. Stanley R. Corcoran. An account is given of some experimental flights with engine-supplemented gliders. The tests were conducted for the purpose of proving the value and efficiency of small auxiliary engines in lifting the glider to altitudes where full advantage can be taken of thermal currents. It is pointed out that, in addition to eliminating more expensive and troublesome launching methods, the auxiliary engines can be employed for assisting the glider to its destination when thermal activity is inadequate. For the tests, two 6-hp., two-cycle engines with counterrotating propellers were installed on a standard two-place Cinema glider. An engine was mounted on each strut. With a gross weight of 750 lbs., performance figures obtained were: take-off run, 500 ft.; rate of climb, first minute, 150 ft.; top speed, 67 m.p.h.; stalling speed, 37 m.p.h.; power-off glide ratio, 15 to 1. *Southern Flight*, November, 1944, pages 32, 33, 4 illus.



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The New York State Education Department Glider Program. Cyril Leigh-Smith. A description is given of how the New York State Education Department's program for glider instruction has been developed. Starting with the establishment in New York public schools of the Industrial Arts Junior Aviation Program immediately following the Pearl Harbor incident, the writer outlines the progress that has been made in glider instruction. *Gliding*, October, 1944, pages 2–4, 20, 3 illus.

History

Air Miracles Come Slowly. John K. Northrop. The President of Northrop Aircraft, Inc., reviews some of the advances in aircraft design and performance which have been made during the four decades since the Wright Brothers' initial flights. He traces the origin of the Black Widow night fighter back to what he calls its roots, which reach down into the sources of fundamental aeronautical knowledge. He shows that the progress of the past 41 years has been of a step-by-step nature and not by great leaps. The achievement of the present speed, power, ceiling, and aerodynamic excellence is attributed to the laborious processes of engineering evolution, and continued progress is predicted. *Air Trails*, December, 1944, pages 23, 94, 1 illus.

Centenary of the First Projected Trans-Ocean Flight. Max Kronstein. An account is given of the first projected transoceanic flight, which was the precursor to a century of American efforts to open the air route across the Atlantic. The efforts of John Wise, nineteenth century balloonist of Lancaster, Pa., to obtain financial backing for the project are outlined. *The Airport Journal*, November, 1944, pages 46–48, 1 illus.

Coast to Coast at Top Speed. A review is given of record transcontinental flights made across the United States. In tracing the successive transcontinental records that were set from 1911 to 1944, the history shows how the time of flight was gradually reduced from 49 days to 6½ hours through the efforts of many men and women fliers. Forty-three flights are included in the list that supplements the article. This list tabulates the flier, date, starting point and destination, time, plane, and record for each flight. *Air News*, November, 1944, pages 43–45, 70, 8 illus.

Inspection

Fluoroscopic Tests. Two fluoroscopic processes for the examination of light-alloy castings are detailed. One is based upon the use of the Perspectrosphere screening machine. This self-contained unit of cabinet shape provides a remote-controlled container for the specimens which, when the specimen is being irradiated, is itself invisible and therefore does not cause masking. With this machine, the specimen can be rotated through 360° and retained in any position for detailed examination or for radiography. The need for any handling of the specimen is obviated.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

The other inspection method employing fluorescence is reported to be essentially for the detection of cracks. It consists of dipping the parts to be examined in a fluorescent liquid of a particularly penetrating nature contained in a thermostatically controlled bath. After immersion, the parts are drained and transferred to an inhibiting bath; then they are removed, allowed to dry, and inspected under an ultraviolet light. Where cracks exist, they are disclosed by the characteristic glow of the fluorescent material adhering to the edges of the cracks. The equipment for this test comprises two tanks separated by a draining rack. The first is provided with a thermostatically controlled heating element set to maintain a temperature of about 70°C., and the second tank contains the inhibiting liquid.

Fluoroscopy is recommended particularly for the inspection of cored passages in castings and as a general control of foundry practice, elimimating unnecessary work for the X-ray testing equipment. Aeronautical Inspection Division requirements concerning the use of fluoroscopy for routine control are outlined. Suitable applications for fluoroscopic inspection are indicated while its limitations are also noted. *Aircraft Production*, November, 1944, pages 511, 512, 2 illus.

Measuring and Designating Surface Finish. James A. Broadston. This is the concluding installment of a three-part article on the measurement of surface finish. The writer discusses methods of comparing surface finishes, stating that comparison can be accomplished without expensive equipment or specialized techniques. He describes various makes of standard specimens of surface roughness and a low-cost roughness comparison gage that is made of plastic. The plastic device was developed by North American Aviation, Inc., and is intended to promote surface-quality control in the plant machine shop, as well as among suppliers of parts located at distant points. *The Iron Age*, November 2, 1944, pages 58–62, 7 illus.; "Surface Roughness Standards for Tactual Comparisons," by James A. Broadston, *Product Engineering*, November, 1944, pages 756–759, 6 illus.

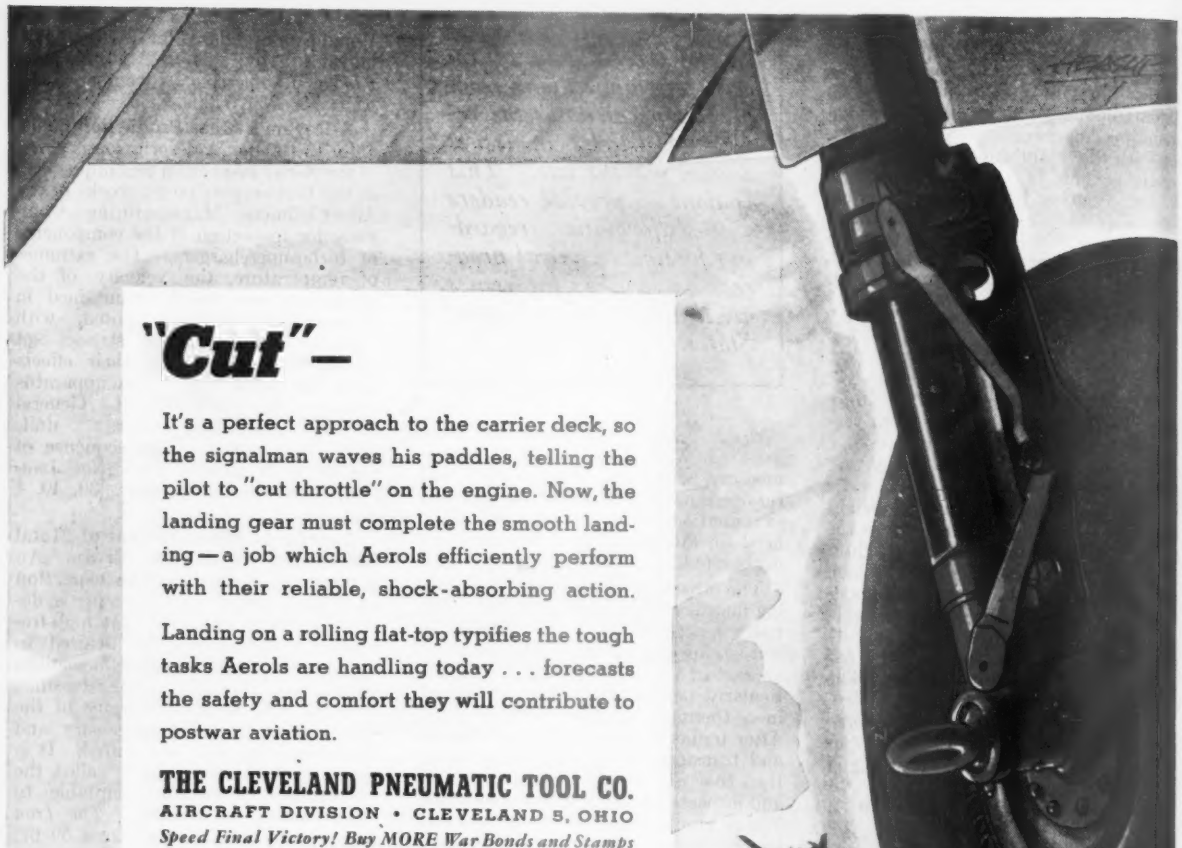
X-Ray on a Mass Production Basis. John L. Bach. A description is given of the X-ray inspection technique used at the turbosupercharger works of the Allis-Chalmers Manufacturing Company for inspection of the components of turbosuperchargers. The extremes of temperature, the velocity of the gases, and the speeds maintained in turbosuperchargers are noted, with remarks concerning the stresses set up by these forces and their effects upon the metals used. The apparatus includes a 1,000,000-volt General Electric industrial X-ray unit, which is described. The sequence of operations is traced. *Industrial Aviation*, November, 1944, pages 39, 40, 4 illus.

Supersonic Measurement of Metal Thickness. Wesley S. Erwin. An instrument designed for the inspection of hollow steel propeller blades is described. It is explained that high-frequency sound waves are utilized to measure the thickness of metal sections where one of the surfaces is inaccessible. Contact with only one surface of the object being tested is necessary and little operating skill is required. It is stated that the instrument, called the "Sonigage," is readily adaptable to other testing procedures. *The Iron Age*, November, 9, 1944, pages 59–61, 3 illus.

Instruments

Airspeed-Dial Device Simplifies Range Procedure. Charles A. Mobley. A procedure card for helping the pilot to obtain maximum range is described. Designed to be attached over the plane's air-speed indicator, this card indicates the optimum air speed for best range by a red arrow, the location of which is corrected for position error and parallax. The aircraft's indicated air speed is also printed in bold type on the arrow in case some installations may not agree properly with the air-speed instrument scale. Five rules on the card serve to remind the pilot of correct operating procedure whenever economy is desired. Rule 1 is said to insure operation near maximum L/D for the usual operational gross weights. Rule 2 makes r.p.m. the major variable. Rule 3 insures operation near maximum brake mean affective pressure for efficient engine operation. Rule 4 stipulates mixture and blower settings for maximum range. Rule 5 prevents operation at too-low engine speed. *Aviation*, November, 1944, page 181, 1 illus.

Instrumentation of 400-Cycle Aircraft Electric Systems. A. J. Corson, A. G. Stimson, and W. A. Soley. This article deals with the problem of obtaining adequate instrumentation at the distribution panel when 400-cycle a.c. is used as the power source on large aircraft. The information that will be



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required by the flight engineer for the intelligent operation of the system is listed. It is stated that a group of four instruments—namely, ammeter, voltmeter, watt-varmeter, and frequency indicator—together with their associated resistors and current transformer, is necessary for use in a.c. systems where parallel operation of several alternators is required. Where nonparallel operation is used, either the watt-varmeter or ammeter can be eliminated. Consideration is given to the distribution system of a three-phase 400-cycle alternator and to the determination of the minimum size and weight which will characterize a satisfactory group of instruments. Subjects discussed include the measurement of current and voltages, the instrument current transformer, the measurement of active and reactive power, and the measurement of frequency. The conclusions reached through this analysis are summarized. Tables give the constants and performance data for certain ammeters, voltmeters, watt-varmeters, and frequency meters. An appendix gives the method of calculating the scale distribution of the frequency meter. *Electrical Engineering*, November, 1944, pages 830–834 (Transactions), 14 illus.

An Italian Artificial Horizon. F. Postlethwaite. Detailed information is given about an Italian artificial horizon having some novel points that differentiate it from familiar types. One feature of the instrument is that the indicating mechanism has complete freedom in both pitch and roll instead of the customary range of movement. Sections of the article are devoted to the general construction of the instrument; the design of the indicating and caging mechanism; and the workmanship, performance, and finish. *Aircraft Engineering*, October, 1944, pages 288, 289, 3 illus.

A Precision Extensometer and Its Use for the Measurement of Poisson's Ratio. W. Lethersich. A description is given of a simple optical arrangement for measuring Poisson's ratio under various conditions of stress and strain. It is explained that previous devices necessitate adjustment of two separate images, whereas the improved apparatus requires only one image and is consequently simpler to use and is adapted to rapid testing. The method is described with the aid of a sketch of the apparatus. Tables are included for checking the accuracy of repetition of tests on such materials as ebonite, polystyrene, and urea formaldehyde. Sources of error are explained, and experimental results are tabulated and discussed. *Journal of Scientific Instruments*, October, 1944, pages 180–183, 2 illus.

Influence of Electricity on Aircraft Instrumentation. C. F. Savage. Factors that have operated to set up conditions favorable to the electrification of aircraft instrumentation are described. Two tabulations are given to indicate the extent to which electrical principles have been applied to common aircraft instruments. The effects upon instruments of increased size in aircraft, larger power plants, longer flight time, association with other equipment, and other factors are discussed. The advantages of electric instruments are described, and some possible future developments are noted. Tables show a classification of aircraft instruments and the principles on which they operate. *Electrical Engineering*, November, 1944, pages 802–805 (Transactions), 5 illus.

Suspension Mount Controls Instrument Vibration. An explanation is given of the operating principles of the Robinson suspension mount for protecting instruments against engine and propeller vibration. With this device, absorption of multidirectional vibration impulses is accomplished by providing neutralizing cushions for each type of impulse by a double-suspension method of mounting the instrument unit. Vibration-neutralizing effects of a Robinson mounting are compared with those of conventional mountings. *Aviation*, November, 1944, pages 139, 140, 266, 269, 7 illus.

An Improved Indicator For Measuring Static and Dynamic Pressures. C. E. Grinstead, R. N. Frawley, F. W. Chapman, and H. F. Schultz. This paper describes an improved design of condenser-type indicator for measuring static and dynamic pressures, and its associated electrical equipment. The principle of operation is explained. Reasons are given why the condenser type of indicator was selected for engine work. It is stated that this type lends itself to compact and sturdy construction, has a high natural frequency, is relatively insensitive to shock and vibration, and does not require mechanical linkage between the pressure diaphragm and the electrically sensitive element. *SAE Journal*, November, 1944, pages 534–556 (Transactions), 44 illus.

Lighter-Than-Air

Volveran Los Mas Livianos? (Will There Be a Revival of Lighter-Than-Air?) In this study of postwar aviation, it is stated that, without disparaging the performance of the modern airplane, consideration should be given to lighter-than-air craft. Comments are made about the characteristics of the dirigible with regard to the comfort of passengers, safety if helium is used for inflation, cruising range, and payload capacity. The writer states that the progress made by the aeronautical sciences in the interval since transportation by means of dirigibles was widely used should warrant a revival of effort to give the dirigible the place it deserves. *Aeronautica (Chile)*, July, 1944, page 32, 1 illus.

Lubrication

Aircraft Engine Lubricating Oils. G. B. Wheeler and F. E. Tobin. A discussion of tests made on new and used lubricating oils and their deposits, the significant features of each, and their relation to aircraft-engine operation and maintenance. Tables are included giving grade designations for aircraft oils, oil-test descriptions and their significance, typical lead-deposit analyses, and the location and extent of such deposits in an engine. *Aviation Maintenance*, November, 1944, pages 50–53, 176, 178, 180, 182, 4 illus.

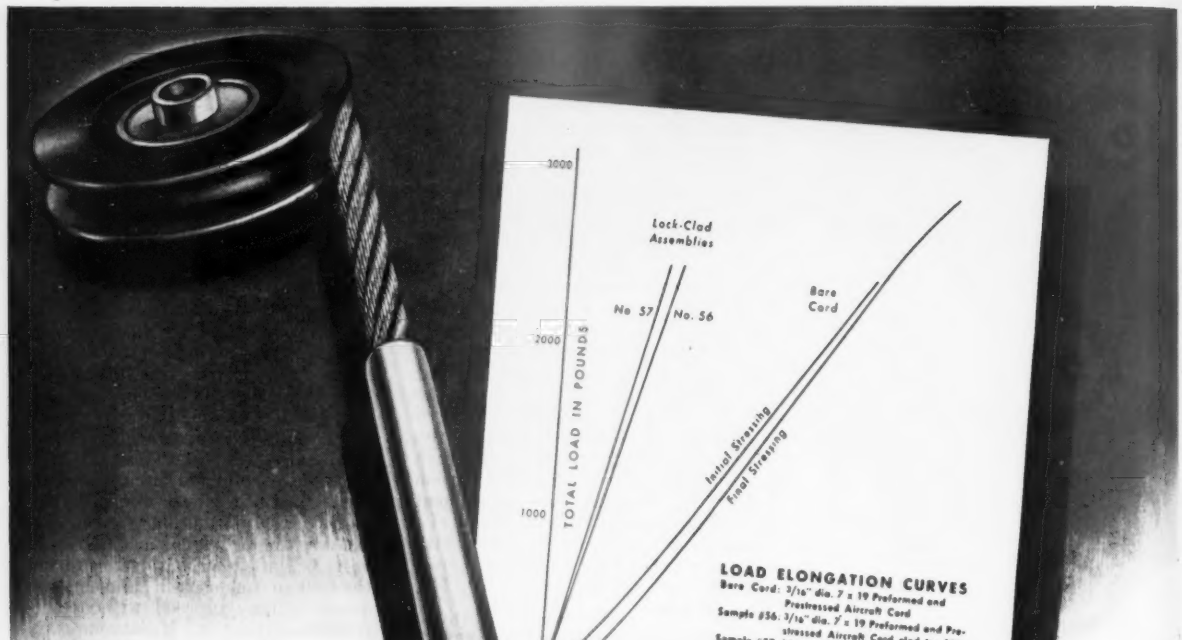
Maintenance

Streamlined Airplane Overhaul. Lt. (j.g.) Burton Schellenbach. Assembly and repair operations at the shops of the Corpus Christi Naval Air Station are described. The writer tells how this shop, which covers about 20 acres, has been expanded in the past few months. It is stated that the shops resemble a complete aircraft manufacturing plant in physical facilities and personnel. Information is given about the way the work is planned and carried out. A shift-flow chart indicates how the time in each shop is planned so that assembly may proceed without interruption. *Aviation Maintenance*, November, 1944, pages 44, 45, 182, 184, 5 illus.

Accessories: What to Leave Alone. Lt. J. Kendall. The writer offers some advice for mechanics in the field and those without specialized experience regarding what accessories should not be touched when servicing a plane. It is stated that all tubing should be let alone until the mechanic learns the proper wrench torque for tightening the nuts on hydraulic lines. It is also stated that no accessory should be removed unless the mechanic has the right tools, test equipment, and knowledge to handle it. *Air Tech*, December, 1944, pages 29, 64.

Reclamation of Bearings. Hudson T. Morton. Techniques of cleansing used bearings and restoring them to their maximum usefulness are suggested. Particulars are given with regard to methods of cleaning, demagnetizing, drying, inspection, and storing. In addition to information about equipment for such processes, advice is included on alkaline solutions, emulsions, solvents, etc., which are used as agents in different cleaning operations. A recommended shop layout for the reclamation of bearings in factories handling large quantities of used bearings is sketched. This plan employs a conveyer system. *Aero Digest*, November 15, 1944, pages 119, 120, 126, 128, 130, 2 illus.

Don't Scrap Spark Plugs. Capt. Donald I. Yous. The writer discusses the care of aircraft-engine spark plugs and tells how to determine whether or not they are in serviceable condition. Three stages in the life of a spark plug are illustrated. Other illustrations show sectional views of various types of spark plugs and how a corrosion-preventive compound should be applied to the shell thread. *Aviation Maintenance*, November, 1944, pages 58, 59, 170, 173, 174, 11 illus.



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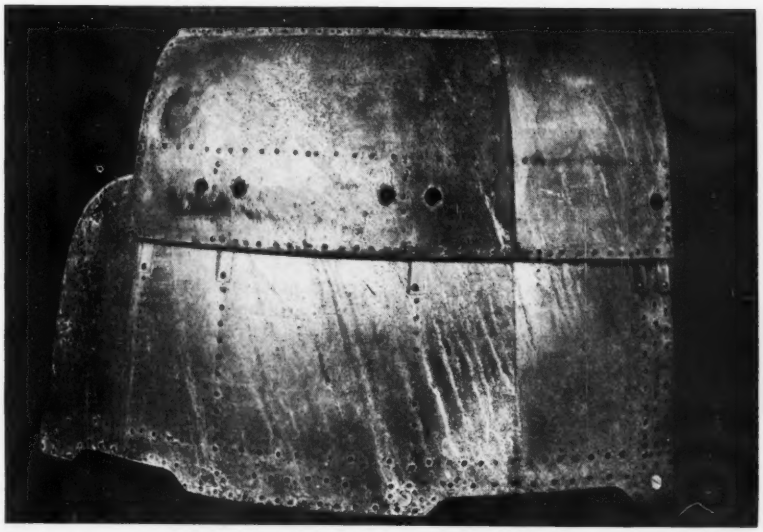
Give 'Em the Data . . . And They'll Fix It—Fast. Dick D. Moyer. The institution of a system that will supply adequate tooling data for Fourth Echelon maintenance depots is urged. It is stated that the dissemination of such data would not only facilitate the fabrication and assembly operations at Fourth Echelon bases but would also help to solve "spare parts" problems. As an indication of the improvements that could thus be made in Fourth Echelon routines, actual problems encountered at a depot in East Africa are noted, and attention is called to the advantages that occurred as a result of the methods followed. The proposal applies to data for air frames only and not for equipment. *Aviation*, November, 1944, pages 112, 269, 271, 272, 275, 276.

Marketing

Marketing Tomorrow's Light Plane. W. R. R. Winans. Bases upon which efficient and widespread marketing of postwar private planes depends are discussed. The need is indicated for: advertising to the general public rather than those who are already "sold" on flying; well-defined sales policies on the part of the manufacturers; better service facilities; more airports and landing strips; effective legislation and community cooperation; energetic dealers and distributors. Attention is directed to the advantage possessed by the airplane dealers over other retailers in that most customers keep their airplanes at the hangars of the dealers from whom they were purchased. This affords continual contacts between dealer and customer and paves the way for further sales of equipment, accessories, etc. *Aero Digest*, November 15, 1944, pages 58, 59, 138, 141, 3 illus.

We Must Sell Private Flying. B. M. Towle. Some suggestions are offered about methods for increasing the sales of personal planes. First, the writer stresses the need for cooperative and "institutional" types of advertising on the part of airplane manufacturers to convince the public of the utility and pleasure value of the small airplane in its present state of development rather than advertising any one manufacturer's product or "the plane of the future." In advocating this course of action, he points out that the manufacturers are better organized and financed to undertake an educational advertising campaign that will benefit the whole industry than are the dealers. The writer then discusses distributor-dealer plans for selling specific airplanes. Rejecting the automobile dealer as a possible representative, he explains his belief that aircraft retailers should have specialized experience and offers certain "pointers" for inclusion in a well-planned sales program. Among the items he advises for the dealer on the field are: better display of the airplane in an attractive showroom intended expressly for this purpose; separation of the sales office from the hangars and clubrooms; and availability of a demonstrator and demonstration model at all times. It is also the writer's opinion that, rather than concentrating on people who already fly, the marketing of private airplanes should be aimed more energetically at the general public not yet "sold" on flying. *Air Facts*, December, 1944, pages 9–13.



To test the resistance to corrosion of welded aluminum-coated sheet steel, a Boeing outboard cowling segment was subjected to 250 hours in a salt spray. Badly burned spots started to corrode within 2 hours but did not penetrate enough to affect materially the strength of the part.

A Place for the Distributor in Aircraft Accessory Sales. Arthur S. Brown. The functions and responsibilities of the distributor in an aircraft-accessories merchandising enterprise are outlined. Advice is also given about how the distributor can perform his job with maximum profit results to himself, to the retailer, and to the manufacturer. In the sales phase of the distributor's functions, it is stated that not only must he sell merchandise but he also must help the retailer with business organization and accounting practices. He must see that the retailer maintains an adequate stock to assure good customer service; suggest display, sales promotion, and advertising programs; and convince the retailer of the quality, usefulness, and profit possibilities of the merchandise he has already sold him. The distributor's responsibility in carrying more complete and larger inventories than the dealer, and in helping to eliminate credit risks to the manufacturer are other functions that are discussed. *Aviation*, November, 1944, pages 121, 302, 303.

Materials

Aluminum-Coated Sheet Steel Rates High in Corrosion Resistance. The development of a coating process that permits the quantity production of aluminum-coated sheet steel is described. Information is given about the physical properties of the material, its applications, and spot-welding characteristics. It is explained that inability to clean sufficiently the steel surface to keep it free from oxides until it could be bonded to the aluminum coating prevented aluminum-coated steel from becoming a commercial product earlier. This difficulty was overcome by lightly oxidizing the cold-reduced sheet or strip and then reducing the thin oxide with hydrogen. The hydrogen protects the clean sheet or strip as it is led beneath the surface of the molten-aluminum coating bath. The results of spot-welding tests made with aluminum-coated sheet, conducted by the Boeing Aircraft Company, are reviewed. *Product Engineering*, November, 1944, pages 762–765, 5 illus.; "Spotwelding and Forming of Aluminized Steel," by O. A. Moon and F. H. Matthews, *Automotive and Aviation Industries*, November 1, 1944, pages 33, 34, 112, 2 illus.

Alloy Complications in Aircraft Scrap. Walter Bonsack. The utilization of aircraft scrap is discussed in this paper, which was read at a meeting of the American Society for Metals. It is noted that an airplane is a combination of many aluminum alloys with other metals and alloys. Utilization resolves itself into the problem of dismantling airplanes and segregating the metals used in their construction. If this can be accomplished economically, the problem of disposal of scrap material into useful alloys is simple. It has been shown that to cut up airplanes and melt the pieces down in the hope of obtaining new and useful alloys is not the proper procedure. The problem of utilizing airplane scrap is stated to be still unsolved and untried. *Aluminum and Magnesium*, November, 1944, pages 33, 37.

Aeronautical Chemistry. Alvin Snaper. Applications of chemistry and chemical research to aeronautical progress are recorded. Chemistry is credited with being responsible for bet-

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ter fuels, stronger alloys, faster engines, and new armament for aircraft. Specific contributions of chemistry to aviation which are cited include the development of high-octane gasoline, noncongealing lubricants, and Triptane; plastics for turrets, windshields, wiring insulation, and accessories; greater destructive properties in bombs; engine protectives; synthetic rubber; rocket bombs and jet-propelled engines; nylon for parachutes; and pilot's clothing and accessories. *Air World*, January, 1944, pages 33, 65.

Medicine

The Terror of the Heights. Major Richard W. Perry. Comments are made about the services of Flight Surgeons in the early days of military aviation and how their work helped in the advancement of the science of aviation medicine to its present position. A tribute is paid to their contribution to the safety of flying. *The Journal of Aviation Medicine*, October, 1944, pages 344–347, 1 illus.

Myringopuncture for Reduced Intratympanic Pressure. Lt. Col. Norton Canfield and Wing Comdr. Geoffrey H. Bateman. This paper reports pressure-chamber experiments in which myringopuncture was used to reduce intratympanic pressure. The experiments were made by the writers of the report acting as, respectively, the subjective and objective observers in a mobile pressure chamber with the cooperation of the Surgeon of the Eighth Air Force and his technical staff. Conclusions drawn from the experiments are enumerated. It is stated that the transtympanic membrane route for introducing air into the middle ear is feasible and can be done without pain by myringopuncture. Consideration of its use on operational air fields is recommended. *The Journal of Aviation Medicine*, October, 1944, pages 340–343.

Airborne Plagues? Major Sedley Peck. A consideration of the possibilities of disease importation into the United States as a result of the speed of air transport. To combat the greater dangers of infection caused by faster transference of people and cargo from one country to another, it is shown that new diplomatic arrangements will have to be made for reciprocal medical examinations and that new health and sanitation requirements will have to be devised. A few diseases that may be transmitted easily from tropical countries are described. These include cholera, yellow fever, bubonic plague, typhus, and malaria. In discussing some measures that have been taken to counteract possibilities of disease importation, the effectiveness of the insecticide DDT is noted. *Flying*, December, 1944, pages 28, 29, 140, 142, 3 illus.

Depth Perception as an Aid in the Selection of Fighter Pilots. Major J. W. Millis. The selection of fighter pilots for special training in gunnery is discussed. It is stated that for better efficiency the student's ability to hit a moving target must be determined more

accurately than is possible by the methods of flying instructors, which are based on the students' reactions and flying ability. The value of depth perception tests in the selection of students is discussed. A practical method to aid in the selection of students for aerial gunnery is described. *The Journal of Aviation Medicine*, October, 1944, pages 328–339, 10 illus.

A Cardiovascular "Blackout" Test. H. S. Mayerson. A cardiovascular test is described in which the systolic and diastolic pressures and the pulse rates are determined before and after a standard amount of exercise with the subject in the "upright" position. Fifty subjects were studied. Twenty-seven showed signs or symptoms of syncope or actually fainted during the test. It was found that this embarassment of the cardiovascular system is related to the low level of systolic pressure, the changes in diastolic pressure and pulse rate being secondary compensatory manifestations. Because of the suggested correlation between susceptibility to fainting and ease of "blacking out" when pulling out of a dive, the test is proposed as a particularly suitable method of selecting pilots for combat flying. *The Journal of Aviation Medicine*, October, 1944, pages 304–315, 4 illus.

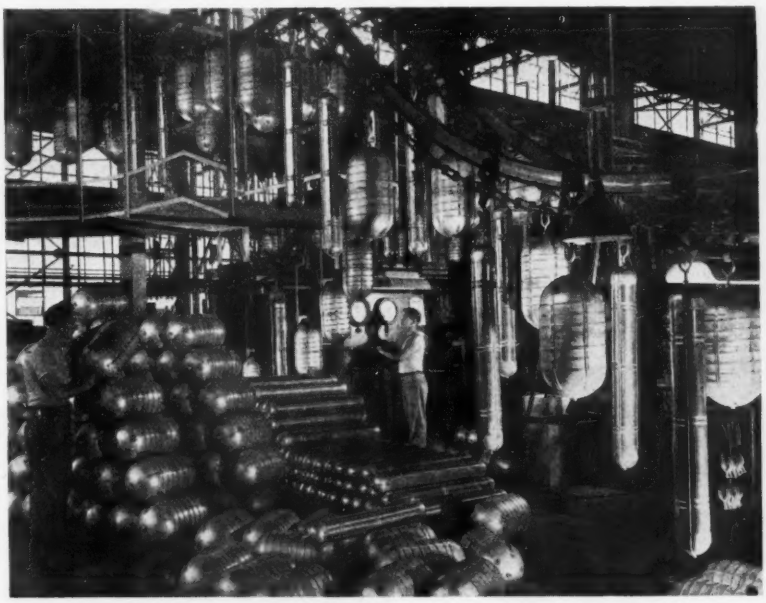
A Physiological Investigation of the Events Occurring When Changing from Oxygen to Air at 35,000 Feet. Major Allen Hemingway. In the high-altitude indoctrination program at the Army Air Forces School of Aviation Medicine, Randolph Field, Tex., the need for oxygen is demonstrated to the future flier by disconnecting his oxygen hose and testing his ability to write. Because this demonstration was being performed frequently, the opportunity was taken to investigate the physiologic events during the onset of unconsciousness caused by high altitude to obtain quantitative information about the duration of consciousness when oxygen failed at high altitude and to estimate the amount of physiologic stress involved. Thirty-one subjects who were breathing oxygen and writing at the simulated altitude of 35,000 ft. in an altitude chamber disconnected their oxygen supply and breathed air. They were unable to write after 55 to 80 sec. of air breathing (average 72.6 sec.). When writing ceased because of anoxia, the blood-oxygen saturation values were 45 to 67 per cent (average 56.6 per cent) as measured by a Millikan oximeter, which had been checked by chemical analyses of arterial blood. From electrocardiograms taken during the anoxia interval, it was found that writing ceased when the beginning circulatory precrisis changes, such as suppressed T-waves and extrasystoles, were evident.

It is concluded that there is practically no danger involved in the anoxiademonstration technique used for teaching purposes. *The Journal of Aviation Medicine*, October, 1944, pages 298–303, 6 illus.

Metallurgy

Anodic Films on German Alloy Parts. This article is based on a report prepared by the Staff of the Metallurgy Division of the Royal Aircraft Establishment for the Committee on Non-Ferrous Parts of Enemy Aircraft. It refers to an examination of anodically treated aluminum-alloy parts taken from several German aircraft. *Aircraft Engineering*, October, 1944, page 304.

The Application of Grain-Size Determination to Magnesium Alloys. C. H. Mahoney and A. L. Tarr. It is pointed out that, since the grain size of magnesium has an important bearing on the mechanical properties of its alloys, it would seem desirable to establish a recognized standard method for its recording and correlation to the mechanical properties. The establishment of a standard for measuring the grain size of this material is discussed. A method for determining and recording magnesium grain-size standards is proposed. A table contains a comparison of grain-size standards. A proposed magnesium network chart is shown. The preparation of the magnesium-alloy specimen for determination of grain size is described. *ASTM Bulletin*, October, 1944, pages 15–20, 8 illus.



A new stainless-steel oxygen cylinder with improved shatterproof qualities is being produced by the Firestone Steel Products Company for all types of American warplanes. This photograph shows a workman stacking the type of cylinder used on the B-29 Superfortress. Another size is seen in the center of the picture, while the employee at right operates equipment used for hydraulic testing of the ability of the cylinders to withstand pressure. It is claimed that these cylinders will not explode even when pierced by a 20-mm. shell.

Military Aviation

Maintaining R.A.F. Transport. The work of repair groups for R.A.F. motor transport equipment is described from a visit to a completely mobile light-repair unit established under active service conditions. The unit is responsible for the maintenance in road-worthy condition of about 3,000 vehicles of all types. It provides for quick repairs, top overhauls, and general servicing. Major overhauls and complete stripping-down jobs are dealt with by heavy-repair depots. *The Aeroplane*, October 6, 1944, pages 392, 393, 6 illus.

Continental Miscellany. John Yoxall. Observations are reported from a visit to some advanced airfields and recent battlefields in Western Europe. Among the things discussed are the accuracy of Allied bombing; the great extent to which air transport is employed in the delivering of supplies to the British army and air force; the jet-propelled airplanes used by the Luftwaffe; the short-range tactical work of the air forces under Air Marshal Sir Arthur Coningham; the rocket-firing Typhoon; and the Spitfire IX. It is stated that the employment of air power in the battles of Western Europe follows the same pattern as that of the Mediterranean. *Flight*, October 12, 1944, pages 392–395, 5 illus.

Requiem for the Wasp. Barbara E. Poole. Arguments are offered in defense of the WASP's utility and record. Objections that have been raised against continuance of the organization are refuted point by point, the writer praising the record of the WAFS, as well as the WASP. Points of contention discussed include: the 35-hour requirement for members of the WASP; their capabilities and reliability as fliers; the economic necessity for their

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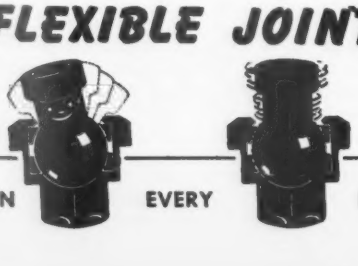

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jobs; and their accident percentage. *Flying*, December, 1944, pages 55, 56, 146, 148, 3 illus.

Fighting in the Dark. The development of aerial night defense in Britain is outlined from 1940 to the present. Technical advances in night-fighting aircraft are noted, as well as progress in radio aids and in the training of night-fighter crews. Attention is called to the problems presented by the night fighter's present adversary, the flying bomb, and to the claim that air crews prefer bombers as targets, rather than flying bombs. *Flight*, October 12, 1944, page 389.

Night Interception. A brief outline is given of some of the successive stages of British night air interception. Beginning with the use of Spitfires, Hurricanes, Blenheims, and Defiants for night fighting at the beginning of the war, it is told how these planes were superseded by specially equipped Beaufighters toward the end of 1940 and later, in 1943, by the Mosquito, which was faster and more maneuverable than the Beaufighter, had a higher ceiling, and had more formidable armament. Development of Mosquito techniques to combat the flying bomb when it arrived are then noted. The article also includes an account of the special temperamental characteristics required of night-fighter personnel, which differentiates them from day-fighting air crews. *The Aeroplane*, October 27, 1944, page 473, 1 illus.

Naval Aviation

Searchers of the Sea. Lt. John B. Goodman. A description is given of the services rendered by what is known as the Navy's "search planes," and of how the Navy versions of the Liberator and Ventura were adapted for this work. These two types of land-based aircraft are being used, in addition to the regular Navy patrol flying boats such as the Catalina, the Coronado, and the Mariner, to find formations of enemy naval craft, report on their location and movements, combat enemy fighters, and sometimes actually attack enemy ships, planes, and land installations. The accomplishments of certain naval air units in this type of work are recounted. *U. S. Air Services*, November, 1944, pages 15–18, 54, 1 illus.

Paints and Coatings

Infra-Red Heating. A detailed study of the application of infrared drying or radiant heat for speeding the drying of paints and coatings is based on two papers read before the Midland Section of the Institute of Fuel and the Midland Junior Gas Association. It deals principally with the use of gas as the heating medium instead of electric power. Three main types of coating which require heat are defined as: (1) paint in which a solvent is evaporated; (2) lacquers in which a solvent is evaporated; and (3) heat-transformable paints in which not only is the solvent evaporated but there is also polymerization of the vehicle. These three main types decide the most practical drying temperature and drying time at that temperature. The success of infrared drying is attributed largely to the development of the polymerizing (type 3) finishes. Information is given about the sources of infrared rays and the intensity, distribution, and absorption of radiation. In tables and a graph, comparisons are made between gas-fired and electric radiant heaters, giving the time required to reach certain temperatures under varying conditions and with different materials.

Two general types of heating unit are described—the medium-temperature unit and the high-temperature unit. In each case, the principle of operation, the construction, and the performance are discussed, with comments on the dimensions, the heating apparatus used, and the results obtained. Certain experimental units that have been constructed are described, one of circular cross section and the other of hexagonal cross section. These shapes have been found to be more efficient because they conform to the shape of the device on which the work is performed. A special unit for heating plastic sheets is also described. The merits of gas-fired units are summarized. *Aircraft Production*, November, 1944, pages 532–537, 12 illus.

Rust Preventive Treatments of Aircraft Engines. Col. R. Aldworth. Information is given regarding the treatments used by the Air Service Command Depot at Fairfield, Ohio, to prevent aircraft engines from rusting during test runs. The specific steps and directions followed are enumerated. *Aviation Maintenance*, November, 1944, pages 67, 148, 152, 3 illus.

Significant Characteristics of Smoothing Compounds. J. J. Oudhoff. The purpose of this article is to acquaint aircraft designers with the limitations of smoothing compounds and to suggest to the manufacturer of the compound the properties required to meet the aerodynamic conditions to be overcome by surface treatment for aircraft. A study is made of the conditions to which the compound is subjected and the effects of this condition on the compounds. The requirements are outlined as resistance to the effects of flexibility of the surface, low temperature, high temperature, moisture, and vibration. The writer explains how all of these conditions occur in connection with aircraft operation, and he describes compounds in current use and their methods of application. The properties of an ideal compound are suggested and the desired qualities are listed under twelve specifications. A satisfactory smoothing compound is analyzed for its different properties and examples are given of the requirements involved in applying and maintaining a satisfactory coating. Tests are described as applied to six different samples of compounds, with information concerning the methods of application. Results are tabulated. *Aero Digest*, November 1, 1944, pages 78–80, 220, 222, 224, 5 illus.

A Plane Is as Fit as Its Finish. John Brennan and Ralph Hall. Paint-finishing procedures of American Export Airlines are detailed. The techniques described feature the elimination of a priming coat and stress the importance of surface-preparation methods for receiving and holding the organic corrosion-resistant coatings. The system of maintaining and restoring flying-boat finishes is traced from the washing and cleansing of surfaces, through the stripping of paint, inspection for corrosive areas, removal of corrosion, and repainting. Various types of finish material used and methods of application are described. *Aviation*, November, 1944, pages 153–155, 263–266, 5 illus.; "What's That Finish?" by George E. Wilson, *Southern Flight*, November, 1944, pages 40, 42, 1 illus.

Personalities

This Possum Is Jap Poison. Sidney Shalett. Brig. Gen. Haywood Hansell, first Chief of Staff for the 20th Air Force, is the subject of this biographic article and character sketch. In reviewing the General's career in military aviation, the writer highlights events that include his participation in the shaping of America's air plan, his affiliation with Claire Chennault in a precision acrobatic-flying team known as "Three Men on a Flying Trapeze," and his direction of the 20th Air Force's operations. Although at one time he was one of the exponents of a separate air force, General Hansell is now reported to be advocating a unified department to combine the three arms of the Service—Army, Navy, and Air Force. *The Saturday Evening Post*, November 25, 1944, pages 17, 94–96, 2 illus.

Meet...Theodore Paul Wright. The career and achievements of Theodore P. Wright are reviewed in a short biographic sketch. His activities are traced from the time of his service as a naval officer after the first World War as inspector of naval aircraft; his connection with Curtiss-Wright Corporation and its predecessors; to his entrance into the Government service with the Office of Production Management, later the War Production Board, and other Government agencies; and concluding with his appointment as the Civil Aeronautics Administrator. *Air*

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Transportation, October, 1944, pages 16, 17, 1 illus.

The Persistent Pioneer. W. M. Morgan. Some brief notes about T. E. Braniff's activities in the air-transport industry. These include reference to Braniff's trade-area plan, his sponsorship of an air-carrier service in Mexico, and postwar air routes for which Braniff Airways have made application. As described, the trade-area plan is based upon service to, from, and between the smaller communities in a given trade area and the trade center. Designed on a wheel-and-spoke pattern, the plan proposes to provide service that would facilitate commercial intercourse between points in the trade area, as well as service to the trade center where connection would be made with all forms of transportation, including the trunk-line air carriers to the rest of the country and foreign countries. *Airlanes*, November, 1944, pages 12, 13, 4 illus.

Count de Lesseps. Frank H. Ellis. Highlights in the aeronautical career of Count Jacques de Lesseps are recorded. The review tells of the air pioneer's flights in both Europe and North America. Among the attainments with which he is credited are those of being the second person to fly across the English Channel by airplane and the first to fly over Montreal and Toronto. *Canadian Aviation*, November, 1944, pages 64–66, 104, 116, 10 illus.

Photography

Precision Templates by "Ray Production." Benjamin Rudnick. A description is given of a process known as "ray production," which is stated to eliminate the disadvantages of transferring engineering drawings to metal. The process embodies the use of spray-coating to reproduce flat working surfaces without the use of a camera. It is explained that with this process the usual intermediate step of making a glass negative is eliminated, there is no possibility of distortion, no X-ray is employed, and the expensive process of sensitizing metal by adhering pliofilm or rolling on paste has been changed to the more economical and more efficient method of spray-coating. *Industrial Aviation*, November, 1944, pages 55, 56, 58, 74, 75, 6 illus.

Fundamentals of Photogrammetric Engineering. Part I. Reynold E. Ask. This is Part I of a two-part article on aerial photogrammetry. It deals with aerial photographs and their use in planimetric mapping. The writer discusses aerial cameras, flying procedure, and photographic materials. The geometric characteristics of aerial photographs are reviewed, with particular reference to scales and displacements resulting from elevation differences and picture tilt. A step-by-step outline is given of the construction of radial plot planimetric maps and mosaics. *Engineering News-Record*, November 30, 1944, pages 80–85, 11 illus.

The use of Micarta landing-strut bearings on Republic P-47 Thunderbolts, effecting a saving of 8 lbs. per plane, permits an additional 31 rounds of 0.50-cal. shells to be carried into action. A bearing is shown being assembled on one of a pair of struts.

Plastics and Plywood

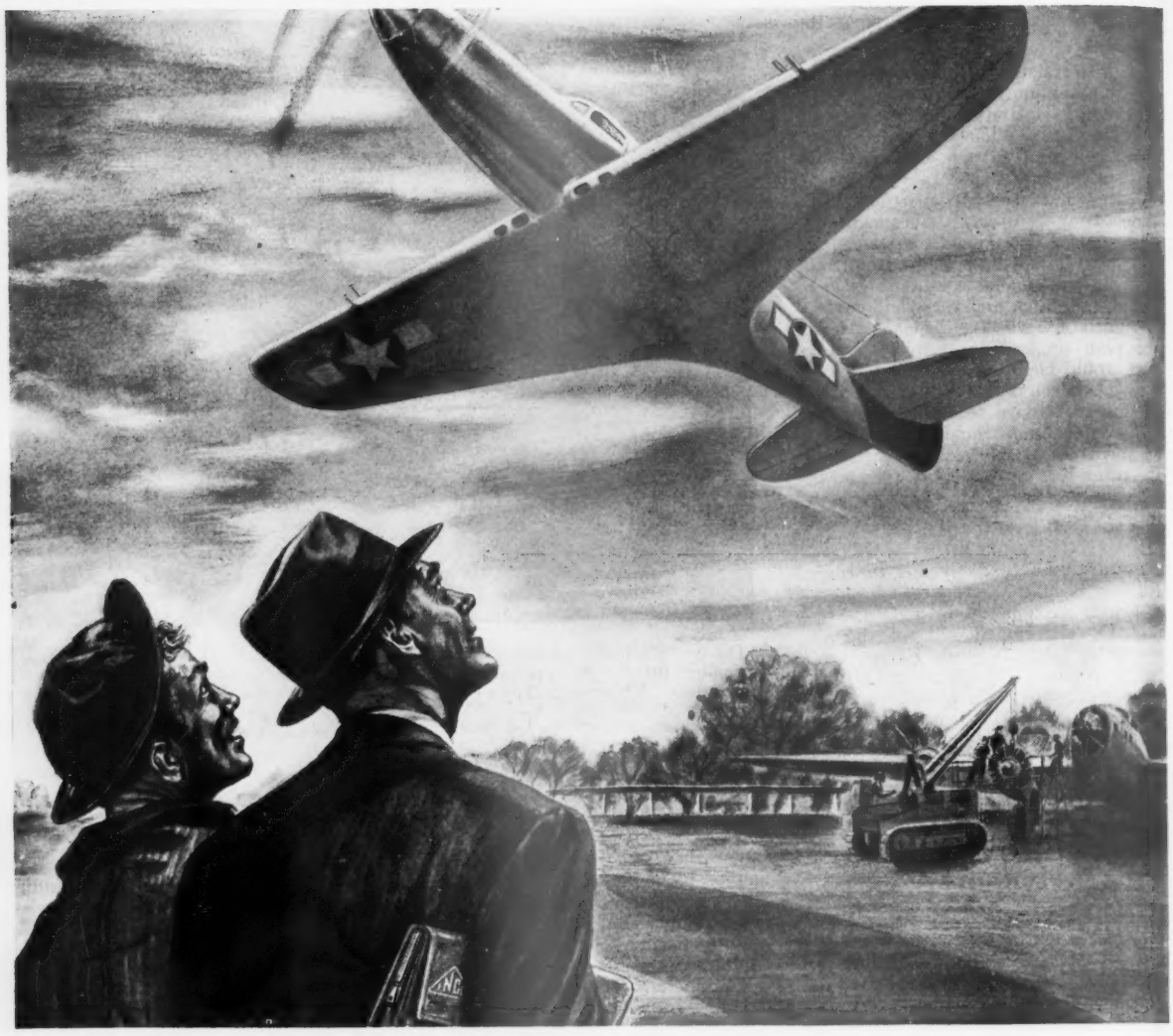
Thermo-Flastic Forming of Laminates. W. I. Beach. It is noted that the thermoplastic (post-forming) method of shaping flat laminated sheet differs considerably from conventional low-pressure methods. In practice, the post forming of fully cured C-stage laminates is similar to metal forming. Like metal, laminated sheets are stretched or deformed by externally applied forces. The results of an investigation dealing primarily with the handling and forming characteristics of laminated stock are reported. The investigation revealed the desirability of always avoiding the use of undercured material. All the thermosetting laminates investigated deformed at their critical softening temperature regardless of the degree of cure. It was found that the optimum formability and maximum retention of physical properties depend largely on the judicious selection of filler material. The investigation also revealed the adaptability of laminates to forming techniques and tools. *Modern Plastics*, November, 1944, pages 132–135, 206, 208, 9 illus.

Gluing Plywood. N. A. De Bruyne. The difficulty of making some types of plywood stick to other wood components is discussed. Reference is made to research, conducted at the Royal Aircraft Establishment, which has established a number of points about this difficulty and its cause. It is stated that the trouble appears to be primarily a mechanical or physical one rather than a chemical one. Conclusions drawn from the investigation are listed, and precautions that will aid in overcoming the difficulty are recommended. *British Plastics*, October, 1944, pages 446–448.

Postwar Aviation

Post-War Civil Aviation in India. Part I and Part II. Frederick Tymms. The Director of Civil Aviation in India discusses the future prospects for civil aviation in that country in a four-part article. To provide a better understanding of the possibilities of aviation in India, the writer gives a brief outline of past developments. Factors that have contributed to aviation development and those that have tended to retard it are discussed. Tables of data concerning external and internal air services are given. The construction and equipment of air routes is described. Principles and policies that bear on the practical problem of air transport are included. Consideration is given to the organization of the air services to render the best service to the public and to make such services self-supporting in the shortest possible period. *Indian Aviation*, July, 1944, pages 172, 174, 176; August, 1944, pages 188–190, 192, 193.

This Administration's Air Policy. Harry S. Truman. The Vice-President-elect of the United States tells of plans that are being made by the Government for the postwar extension of airport facilities. Indicating the economic and social advantages to be gained from such a program, he stresses particularly the fact that it will provide jobs for returning servicemen. He also reviews some of the airport-development work that was sponsored by the present governmental administration since 1935. In this review he notes the



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contributions of the Works Projects Administration toward this development.

The contemplated project calls for the spending of $1,000,000,000 in the first 5 postwar years for the development of airports and landing fields. With an estimated expansion of 3,000 additional civilian airports during this period, 29 out of every 30 new airports would be smaller types of landing fields, suitable for private flying and small-business aviation ventures. Half of the cost of the landing facilities would be paid by state or local governments, which would make the plans, and half by the Federal Government. Under this plan, it is stated, there would be 1,827 cities with air-transport service instead of the present reported number of 286. *Flying*, December, 1944, pages 21, 156, 158, 1 illus.

Are You Another Aviation Prophet? E. Marion Johnson. The postwar outlook for commercial and private aviation is discussed. While the writer predicts a bright future for postwar air transport, he warns against overoptimism. Figures are presented which tend to discount the idea that immediately following the war the United States will have great numbers of extremely large airplanes, each carrying scores of passengers with all the comforts of a deluxe hotel. Six reasons are given for the belief that feeder operations will not be expanded to the extent predicted by many observers. These include the difficulties involved in competing with short-haul surface transport in the matter of rates, schedules, and traffic density. Certain kinds of feeder lines are stated to be feasible. Air-cargo potentialities and the use of different types of aircraft also are discussed. *Air Transportation*, October, 1944, pages 22–25.

The Beck Plan. Franklin D. Walker. Thomas H. Beck's proposal for facilitating postwar reconversion in the aviation industry through the leasing of surplus aircraft to air lines is reported. The scheme requires that the renting of surplus airplanes by the Government be contingent upon the condition that the lessors place orders for new planes at the time the lease is signed. As outlined, the program contemplates the offering to recognized air-line operators of all personnel and cargo-type transports, finished and usable or in process when the war ends, in their existing condition for conversion and civilian use on the following basis: (1) Planes will be rented or leased for, say, $50 per day to all legitimate foreign and domestic licensed carriers who have or will place with American aircraft manufacturers orders for new planes of equal or greater pay loads. The terms of such contracts must be acceptable to the Federal Government and to American manufacturers. The rentals would be negotiated on a plane-for-plane basis and for no longer than the period of time required to deliver each new plane. (2) Rentals or leases on this plane-for-plane plan shall be made, provided the orders for new planes are bona fide and accepted by the manufacturers with deposits of 25 per cent or more of the price. (3) Rent money, in whole or in part, may be credited against the purchase price of new planes on terms acceptable to the Government and to the manufacturer. (4) Planes rented or leased in this manner shall, upon return to the Government, be disassembled and reduced to original materials and sold as such, or put in a Government stockpile, unless there is demand for renewed similar transactions on a plane-for-plane basis with the same or other buyers of new planes. (5) All personnel and cargo planes not needed for use as outlined here shall be reduced to scrap metal and subject to such salvage of parts as public interest may require. *Flying*, December, 1944, pages 27, 144, 146, 2 illus.

The Economic Future of Aviation Technology. Part III. Frederic Flader. Third article in a series appraising the value of various aircraft types in the economics of postwar air-line operating costs. Consideration is given to the technical possibilities of meeting postwar requirements for lower shipping costs through the use of airplanes powered by propeller-turbine power plants. With the analysis applied to an intermediate postwar transport using propeller-turbine power units with and without regeneration and to a future combination passenger-and-cargo transport with propeller-turbine engines and regeneration, it is shown that the utilization of propeller-turbine power plants could result in rates of 31 cents per ton-mile for aerial transportation. Tables and graphs supplementing the article summarize the characteristics of the suggested airplanes, flying and ground expenses for each, and per-ton-mile cost of operating the various aircraft discussed. *Aviation*, November, 1944, pages 113–115, 3 illus.

Private Flying

Postwar Private Flying. Col. James C. Fitzmaurice (Retired). Demonstrating the importance to national security and economy of popularizing private flying, the writer discusses some of the main factors that call for immediate attention in the establishment of a sound and effective postwar private-flying program for Britain. He proposes the creation of an Aircraft Owners' and Pilots' Association affiliated with the Automobile Association and describes the functions of such an organization and the duties of its officers. He outlines the specifications for landing strips that would form the nucleus of a national airport system. He also advocates the creation of a Joint Civil-Military Aviation Training Committee to assure that the private flier will be qualified to play a useful part in national air defense during times of emergency. *Flight*, October 5, 1944, pages 373–375.

Personal Planes. R. C. Oertel. This article suggests improvements in the service rendered to personal planes by fixed-base operators with particular reference to the dispensing of petroleum products. It is stated that an examination of the buying habits of the automobile driver may suggest practices that will bring the operator more business. The establishing of a scale of prices for gasoline is discussed. It is suggested that airplane facilities of the future should be such as to obviate the necessity for any guidance in taxiing to a point of service and that the service facilities should be such as to require a minimum of labor. *Air Tech*, December, 1944, pages 28, 72, 3 illus.

Engineering Your Personal Plane. Edward R. Burn. An investigation is made of the requirements for personal aircraft after the war. Starting with a brief review of the factors that must be taken into consideration by an engineer preparing to design a private airplane, the writer notes that four basic types are available—the conventional airplane, the two-control or coordinated-control airplane, the helicopter, and the roadable airplane. He describes these four types and discusses the considerations that would affect the decision as to which type would be likely to find a satisfactory market. Reasons are given for the opinion that the conventional-type light plane is most desirable from the standpoint of the prospective average airplane buyer. An outline is given of four versions of this type of aircraft, which is expected to be offered by Aeronca Aircraft Corporation. These are: (1) a low-powered inexpensive plane that will be a revised version of the prewar light plane, to sell at around $1,000; (2) a medium-class airplane of good performance for cross-country flying, having a cruising speed of 100 to 110 m.p.h., to sell around $1,500; (3) a high-performance craft with retractable landing gear, with a speed of 120 m.p.h., to sell at about $2,000; (4) a four-place family airplane, probably powered by a 150-hp. engine and designed to sell at about $3,500. The prices mentioned are based on prewar costs for material and labor. Characteristics of these proposed postwar airplanes are discussed, as well as the material to be used in their manufacture and the performance expected. *Air Trails*, December, 1944, pages 28, 29, 82, 84, 86, 87, 3 illus.; "New Wrinkle in Merchandising," *Air Transportation*, October, 1944, pages 62–64, 4 illus.

Operator-Responsibilities Rule Air Future. E. J. Foley. Seeing that a private surface vehicle is kept in proper condition for operation is stated to be the responsibility of the operator. Operator responsibility assumes increased importance, however, when air is the medium of travel. Running out of gasoline because of failure to replenish the tank is not serious with an automobile, but with an airplane the situation is different. It is stated that it is unlikely that the private plane owner will be qualified or willing to do more maintenance work on his plane than on his car. *American Aviation*, December 1, 1944, page 76.

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Production

Spar Production. Part I. Wilfred E. Goff. First of a series of articles dealing with the techniques developed by Armstrong Whitworth Aircraft Ltd. for the production of Avro Lancaster spars. Part I contains details about the equipment and processes used in the machining of the outer-wing spar booms. Beginning with an account of the development of special milling machines and other fixtures for the manufacture of the spars, it continues with a review of the spar-boom design. It then traces the sequence of actual machining operations. The information given includes reference to slitting, staggered-cutting machining, milling of the spar-boom steps, variable-angle machining, milling of the long- and short-wall tapers, milling of the base taper, frazing, and straightening. The concluding portion of the first installment describes the pneumatic swarf-removal plant, specially developed for Lancaster spar-boom milling operations, which draws the chips directly away from the cutters and removes them not merely from the machine but from the shop. *Aircraft Production*, November, 1944, pages 550–558, 26 illus.

The Technique of Bending Copper Tubing. Julius Wile. Following the prediction that when conditions are more favorable copper will be used more extensively in aircraft production, the writer proceeds to review tube-bending procedure with particular emphasis on details applying specifically to copper, brass, and bronze tubing. *Industrial Aviation*, November, 1944, pages 59, 60, 77, 4 illus.

Chemical Cleaning Practices for Spot Welding Aluminum Alloys. F. M. Morris. This survey is based on answers to questionnaires regarding chemical cleaning practices for spot welding provided by 30 aircraft companies. It refers to vapor degreasers for heavily soiled parts, made in mechanical dies where lubricants are used, and also 17 different alkaline types of precleaners and nine acidic types of oxide removers. The survey reveals wide variation in practices by different companies. These include differences in the immersion time for the same aluminum alloys, differences in the number of spot welds made between electrode cleanings, and lack of uniform results in the use of oxide removers. A typical cleaning routine for Alclad is outlined in eight steps. *Aluminum and Magnesium*, November, 1944, pages 26–30.

Current Trends in Soviet Aircraft Production. Andrew J. Steiger. This survey of current trends in Russian aircraft production is based on available data released in the Russian and American press. The paper, magazine, or yearbook in which the quoted figure or fact first appeared is credited in each case. Information includes reference to growth, design, materials, production methods, labor, and output. As summarized, the main trends are: (1) Although American prototypes have been followed, Soviet plane production and design are developing largely along original lines; (2) wartime expansion appears to have been most rapid in the production of fighter aircraft and attack bombers; (3) output has increased greatly and is rising constantly as a result of the complete reorganization of factory work to quantity-production methods; (4) productivity of labor is also increasing, while net cost is being reduced steadily.

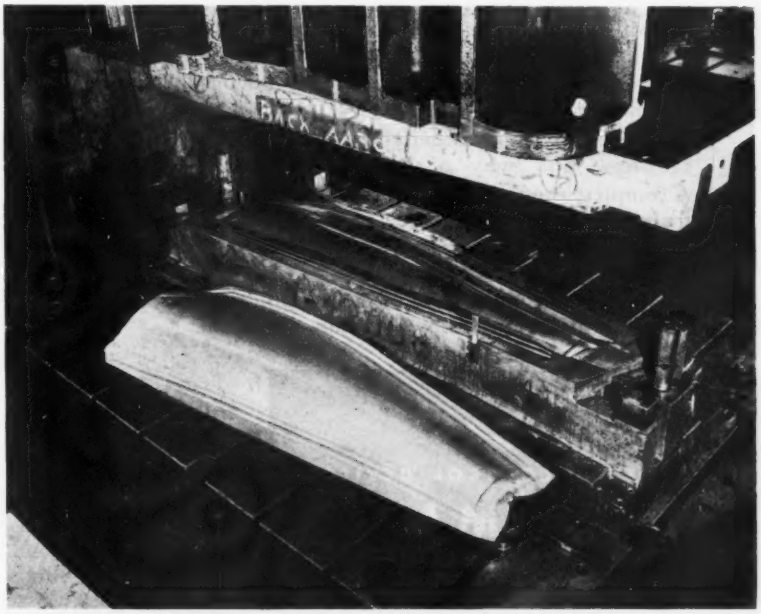
Among the stimuli to increased production which are discussed in the article are a new mill for processing aircraft aluminum-alloys, the introduction of new fabrication techniques, and the employment of semiskilled labor on a large scale. Production flow lines that have been developed are noted to be of three main types: (1) the usual assembly conveyer with forced rhythm moving at a fixed speed; (2) the alternating or pulsating flow line, in which large mechanical aggregates are built up as they move in trucks fixed to a continuous haulway that alternately stops and goes; and (3) the staging of stationary method. *The American Review of the Soviet Union*, November, 1944, pages 37–45.

Designing Aluminum Forgings. Stanley V. Malcuit. The principles of aluminum-alloy forging design are included in this article. Recommendations are given for achieving high quality aluminum-alloy forgings and for simplifying their production. The advantages of aluminum-alloy forgings over castings of the same materials are outlined. The writer discusses various design factors, the different forging alloys, the proportioning of the forging, forging dimension, tolerances, and stress and strain. The mechanical properties of aluminum-alloy forgings are given in tabular form. *Metals and Alloys*, November, 1944, pages 1319–1326, 15 illus.

Deep Drawing and Forming of Magnesium Sheet. Arthur E. Meyer. A description is given of methods of accomplishing deep draws in a single operation with magnesium sheet. The writer supplements his own experience with an exhaustive study made in other plants. Sections of the article deal with sheet-heating furnaces, the heating of the dies, the use of pancake-type dies, and overcoming the inherent springback of magnesium. The writer also discusses hot-pressing compared with die casting, the shearing of magnesium sheet, the Guerin process, rolling cylinders of magnesium, and drop-hammer stampings. Aircraft parts made from magnesium sheet are illustrated. *The Iron Age*, November 30, 1944, pages 44–50, 11 illus.

Stampings in Present Day Aircraft Production. Ernest C. Morse. An outline is given of how the increased use of stampings and the application of quantity-production techniques developed by the pressed-metal industry have made it possible to meet the heavy demand for military aircraft. To give an idea of the wide range of stampings now used in airplane construction and their importance in speeding up production, examples are included of the way certain parts are now being fabricated. *Steel Processing*, November, 1944, pages 712, 713, 2 illus.

Nomographs Facilitate Sheet Metal Layout. B. Mattson Compton. The advantages of the nomograph method



A typical draw-die operation used by the Fisher Body Division of General Motors Corporation in manufacturing cells for the Boeing B-29 bomber.

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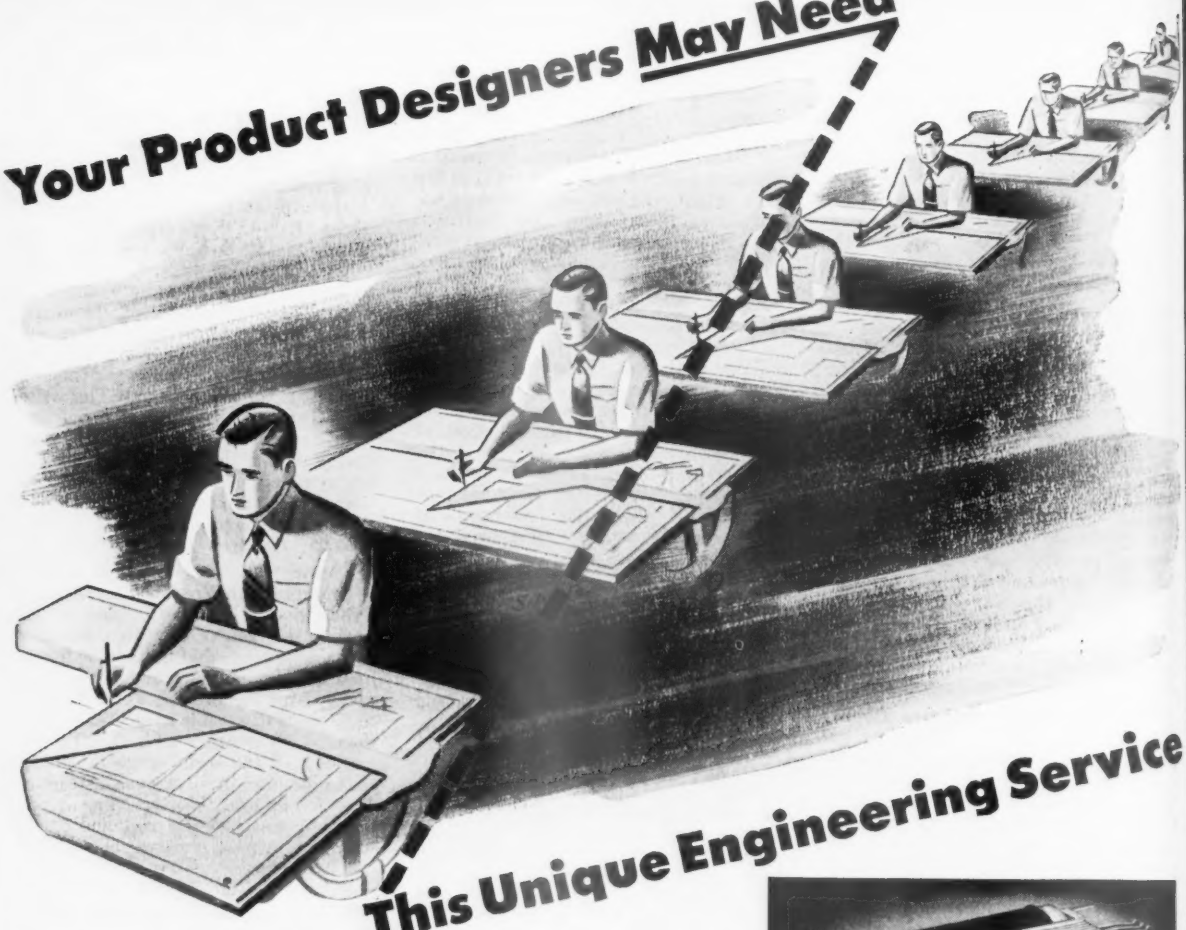

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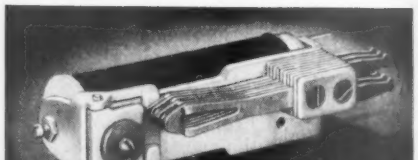

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of solving problems in sheet-metal layout are compared with methods involving conventional mathematics and the trial-and-error method. Four charts accompany the article, two of which are similar to existing charts. The first is a setback chart; the second, a combination bend-allowance and setback chart for 90°. The third is called a mold-leg chart, the use of which is explained, and the fourth is designated as a bend-allowance chart which, the writer states, is presented for the first time in this article. Practically all layout problems associated with sheet-metal work can be solved with this chart.

The writer describes four typical layout problems: (1) developed length and width; (2) template layout for the part; (3) template layout for form blocks; and (4) layout line for aligning the part in press brake. Numerical examples are given for finding developed length and width for form blocks, showing how the mold-point dimensions and angles of bend are determined. *Aviation*, November, 1944, pages 146, 147, 303, 305, 8 illus.

An Appraisal of Precision Thread Rolling Practice. Frank J. Oliver. In a three-part article the writer appraises the many factors bearing on the problem of rolling threads in high-strength alloy steel having hardness ranges up to 36 Rockwell and with tolerances corresponding to Class 3 and Class 4 fits. Reference is made to the trend toward the use of the rolled thread in the aircraft industry in place of ground thread for high-precision work. Part I discusses the general principles involved in precision thread rolling and describes the characteristics of both straight and cylindric die machines. Various types of such machines are described in detail, with remarks concerning their features.

In Part II the writer discusses machine ratings. It is stated that in rolling high-strength materials these ratings should be halved if accuracy is to be obtained. Corrections to be made for accuracy are explained, and consideration is given to die-design factors. A comparison is made of the performance characteristics of several grades of tool steel employed for flat dies, accompanied by tables summarizing the data.

Methods of obtaining rigid control of blank diameter are discussed in the concluding section of the article, and typical thread failures are analyzed. How the cooling and filtration of lubricants adds to die life is described. *The Iron Age*, November 2, 1944, pages 48–55, 132, 134, 15 illus; November 9, 1944, pages 69–74, 8 illus.; November 16, 1944, pages 64–69, 17 illus.

The Design for Production of Sheet Metal Aircraft Parts. Frank M. Mallett. This paper divides into two parts the problem of the control of the design of sheet-metal parts for aircraft. The first part is the determination of the working limits of elongation and compression in different types of sheet-metal forming, and the second is the application of those limits to the design for formability. The discussion

Photograph Courtesy Aluminum Company of America

Polishing the surface of a crankcase forging die. This operation removes all tool marks so that a better product is obtained and the forging can be readily removed from the die.

concerns the second part of the problem. An analytic method of approach is suggested and is illustrated by five examples.

Formulas are given for curved flanges, flanged holes, and beads. Formulas are also given by which the amount of elongation or compression called for by the design may be computed directly from the dimensions specified by the design. A possibility for a refinement in the use of the formulas is indicated, and an experimental method for achieving this refinement is suggested. *SAE Journal*, November, 1944, pages 526–533 (Transactions), 12 illus.

Industrial Perspective. E. J. Rice. Some of the problems connected with the use of pictorial drawings and illustrated instruction sheets are discussed. Consideration is given to their use in overcoming the problems arising from the employment of unskilled labor. The writer describes how perspective drawings may be used to bridge a gap causing production delay where war conditions necessitate the dispersal of factories. The use of constructed perspective drawings in the development of new ideas is discussed. Perspective-drawing methods are outlined. *Aeronautics*, November, 1944, pages 36–39, 5 illus.

Fisher Body Builds B-29 Nacelles. The methods utilized by the Fisher Body Division of General Motors Corporation in fabricating nacelles for the B-29 are described. It is stated that the achievement of assembly-line production of these components required approximately 18,000 jigs, fixtures, tools, and dies. At one of these plants, this work utilized completely a seven-story factory, which in time of peace was capable of turning out 5,000 sets of automobile-body panels per day. The layout of the various plant departments and the operations taking place in each are followed by means of a detailed description of the equipment and the functions performed by the various machines. Numerous examples of the saving of labor are cited, as well as the experiences of the organization with the various types of dies, processes, and other tools. The sequence of operations is outlined from raw-material stores, through the fabricating department, to the complete assembly. *Aero Digest*, November 1, 1944, pages 90–92, 95, 136, 18 illus.

Electric Furnace Brazing Being Widely Extended. Parts I and II. H. M. Webber. A two-part article describes the process of electric-furnace brazing as applied to the production of components for ordnance and aircraft.

In Part I the writer tells how the assemblies made from stampings, screw-machine parts, and tubing brazed to each other or to other parts have replaced former methods of fabrication. Detailed descriptions are given of the methods employed and the advantages gained.

In Part II he gives further examples of how electric-furnace brazing has made possible the production of stronger and less costly components than formerly obtained. Among the parts described are a cooling fan for an aircraft auxiliary-power unit, and a bomb-door roller-support bracket. A description is also given of a new type of combination brazing and heat-treating furnace. *The Iron Age*, November 16, 1944, pages 48–52, 11 illus.; November 23, 1944, pages 52–56, 9 illus.

Propellers

A Portable Airscrew Balance. The purpose, construction, and operation of the Rotol portable balance for propellers are described. With this unit, a propeller can be set up and balanced in any small enclosure that gives a reasonable amount of protection from air disturbances. This not only permits balancing of a propeller in the field but also eliminates the need for the removal of certain units as required in balancing on the conventional knife edges in a static chamber.

Essentially, the portable balance consists of a hollow cylinder having on its outside cone supports that locate upon the front and rear cone seats of the propeller hub. Inside this cylinder a spherical joint is fixed in relation to the cone seats. This joint is adjustable vertically to bring the point of support as near as possible to the center of gravity of the whole assembly. An indicator plate, located on the suspending rod, slides over a scale plate inscribed with a concentric ring. This ring is of slightly greater diameter and gives an eccentricity reading, thus indicating the heavy side of the propeller. Weighing approximately 55 lbs., the entire balancing unit can be carried in a wooden case measuring 24 by 8 in. *The Aeroplane*, October 13, 1944, page 426, 4 illus.

Pneumatic power—Boeing's answer for F-A-S-T operation of the bomb bay doors on the Superfortress—now can be revealed. And Pacific Division also can announce that the air bottle used in the B-29 system together with the four cylinders that actuate the doors are Altair products. Both air bottle and cylinders are modifications of standard Pacific Division hydraulic units, which are in use in virtually every U. S. military airplane.

In developing this new-to-aviation medium, Boeing engineers have perfected a lightweight super-fast method of actuation and Pacific Division is proud of its part in this pioneering work. Pacific Division, Bendix Aviation Corporation, 11620 Sherman Way, North Hollywood, California. Sales Engineering Offices, New York and St. Louis.

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ALTAIR PRODUCTS . . . PACEMAKERS IN AVIATION

The Stressing of Deflected Propeller Blades. C. F. Hodson. This paper discusses the progress made since 1930 by the Fairey Aviation Company, Ltd., in methods for ascertaining the relief centrifugal bending moments caused by bending deflection in twisted propeller blades. A method of guided successive approximation is given for evaluating the net stresses in a flexible propeller blade after deflection relief. This guidance is given by a simple hypothesis relating net bending moment to relief moment. The method was developed following experience gained in the use of the late P. A. Ralli's work on the equilibrium of loaded impeller blades and originated in a desire to reduce the work involved in his more accurate method. Twisted blades of irregular alignment are referred to. When combined with a method employing a series of residual bending moments, errors in total tensile stress are reduced below 0.2 per cent throughout the blade after the second approximation. Three methods are discussed and complete arithmetical examples are given. Other methods are mentioned briefly. *The Journal of The Royal Aeronautical Society*, October, 1944, pages 462–480, 6 illus.

Radio

Make Way for Aircraft Radio. Sidney Nesbitt. The necessity for simplifying Federal regulations on the operation of two-way aircraft radio equipment is demonstrated. Indicating the advantages of two-way aircraft radio and predicting the removal of the "high-cost" obstacle to more general ownership of such equipment after the war, the writer reviews some of the problems connected with Government requirements for operating a two-way radio before the war. He discusses the difficulties and red tape that were attendant upon obtaining (1) the radio telephone operator's license, (2) radio station license, (3) new weight and balance calculation on the airplane and consequent relicensing, and (4) 6-month frequency checks to determine whether the transmitter crystals were on frequency. In order to facilitate the acquisition of radio licenses, the writer suggests that aircraft distributors and dealers and airplane accessory sales and service depots be equipped to issue some, if not all, of the licenses required by the Civil Aeronautics Authority and the Federal Communications Commission. *Flying*, December, 1944, pages 47, 138, 140, 1 illus.

Radio-Noise Elimination in Military Aircraft. G. Weinstein, H. H. Howell, G. P. Lowe, and B. J. Winter. Recommendations and design procedures for reducing radio noise caused by the operation of electrical equipment of aircraft are outlined. The recommendations are specifically for the frequency range of 0.16 to 20.0 megacycles, and in this discussion all wiring is considered to be unshielded except ignition circuits where conduit is required for mechanical protection. The ways are listed in which various radio frequency energy components caused by transient electrical disturbances are induced in the radio receivers. These include voltages generated by current-interrupting devices in the airplane, the power wiring in the fuselage, and the ignition system. The principles involved in designing for radio-noise elimination are discussed in sections dealing with basic radio-installation design, the allowable level of conducted radio noise, methods of filtering conducted radio noise, and ignition-system noise. The testing of the completed installation in the airplane is discussed. The conclusions are summarized as follows: The design must be fluid enough to permit changes during tests on the prototype plane; a compromise system of filtering is the most practicable means of radio-noise suppression within the fuselage; a calibrated-receiver method of evaluating the equivalent microvolts of noise should be the final test of the receiver installation; noise levels of 500 to 1,000 microvolts, if specified for aircraft electrical equipment, would permit satisfactory radio-noise levels with minimum filter weight. *Electrical Engineering*, November, 1944, pages 793–795 (Transactions), 6 illus.

FM Radio for Flying. Karl H. Stello. Static-elimination, low price, light weight, greater reception dependability, reduced antenna difficulties, and the necessity for fewer frequencies are among the advantages claimed in an article outlining the practicability of frequency-modulation radio for aircraft. Principles of frequency-modulation radios and how they operate are explained. *Southern Flight*, November, 1944, pages 41, 42, 1 illus.

Flying with the Visual Beam. Edward H. Kunkel. This article explains the operation of the visual beam for radio-range flying. It tells how the replacement of visual indications for aural methods in receiving radio signals results in more rapid recognition of signals, obviation of the need for the pilot to wear headphones, reduction of static, and almost complete elimination of the false cones of silence. *Air Pilot and Technician*, November, 1944, page 22, 3 illus.

Postwar Plan No. 1 for Civil Airways. Charles I. Stanton. The Deputy Administrator of the Civil Aeronautics Administration discusses the C.A.A.'s plan for converting the entire Civil Airway system to Very High Frequency radio facilities. Explaining the advantages of V.H.F. as opposed to the limitations of the present low frequencies, he tells how the changeover will be made, how much it will cost, and how long it will take. It is pointed out that the new grid system of long-range stations, which is planned as an adjunct to the scheme of new radio frequencies, will permit scheduled air carriers and others to fly Great Circle courses and still be under control of a planned traffic procedure.

The writer also predicts that, after the entire system of ranges has been converted to V.H.F. (which will take an estimated period of 3 years), the air traffic will probably be divided into two classes: (1) Private flying and local flights, together with short feeder-line flights, will operate at lower altitudes, using V.H.F., and (2) longer flights, of 600 miles or more and nonstop transcontinental flights will be made at higher altitudes, probably 12,000 ft. or more. His report includes a description of the localizer, glide-path, and marker-beacon equipment for making landings safe in zero-zero weather. *Skyways*, December, 1944, pages 54, 100, 102, 1 illus.

Reaction Propulsion

Jet Propulsion and Adiabatic Expansion. E. Burgess. It is stated in a brief note that the jet-propulsion idea is really an advanced development of the air-augmented rocket, but for jet-propulsive systems the primary purpose of the fuel is changed. The main function of the fuel carried in a rocket is to eject its own mass with a high velocity, thus propelling the body of the rocket in the opposite direction, while in the liquid-fuel jet-propulsion system the purpose of the fuel is to apply heat to the injected air that ultimately forms the main mass of efflux. A graph is shown which gives the efflux velocities of heated air for various temperatures and pressures of the combustion chamber. Complete adiabatic expansion is assumed to take place from combustion-chamber to ambient pressure. *Flight*, October 5, 1944, page 371, 1 illus.

Rocket Experiments in Manchester. E. Burgess. Experiments conducted by a group of rocket enthusiasts in Manchester, England, about 10 years ago are described. It is noted that while the work was not of great scientific importance, a large amount of practical experience was gained about the laws of rocket motion. Primarily, the work consisted of the taking of normal commercial powder-rocket tubes and attempting to improve them by reducing the weight of the container and by adding special nozzles. Experiments were also conducted with launching apparatus, step rockets, and fuels. Research difficulties that were encountered are outlined. An experimental rocket plane having a rotary powdered-fuel rocket engine supplemented by air injection is described. *Astronautics*, September, 1944, pages 6–10, 10 illus.

Jet Propulsion as Applied to a Helicopter Rotor. W. B. Brzozowski. The application of jet propulsion to a helicopter rotor is analyzed. It is noted that the problem is practically the same as that of Segner's mill. Consideration is given to the case of a straight rotor blade in which the air passes through the rotor arms and the direction of ejection is tangent to the circle described by the orifices as they rotate. Equations are developed for determining the energy imparted to the rotor and the efficiency of the rotor. The case where the air is heated before

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it enters the blades is also discussed. Frictional loss is not taken into consideration in the analysis. It is stated that for exact results this should be calculated. *Polish Engineering Review*, July-August, 1944, pages 48–50, 5 illus.

Reconversion

Contract Termination—Key to Airpower and Security. J. Carlton Ward, Jr. Eight points are proposed by the President of Fairchild Engine & Airplane Corporation as a basis for a contract-termination program that will maintain the aircraft industry's solvency while assuring the country's possession of adequate air power. Summarized, the eight points are: (1) Termination and disposal officers should be enabled to make prompt decisions. (2) Settlements should be negotiated with a minimum of "paper work," formulas and statements. (3) The contractor should be permitted greater latitude in settling subcontractor and vendor claims. (4) Cost-plus fixed-fee contract termination procedure should be clarified. (5) Consideration should be given to the problem of increased costs resulting from partial terminations. (6) There should be preplanning for terminations. (7) A simplified method of material inspection should be permitted. (8) Government agencies should coordinate and cooperate. *Aviation*, November, 1944, pages 110, 11.

Rotating Wing Aircraft

Design for Helicopter Maintenance. Charles E. Bossi. The importance of providing for maintenance when planning the design for a helicopter is emphasized. The first consideration is stated to be that the basis structure should be so designed as to permit the easy removal of the major components with the least disturbance to other parts of the aircraft. Because the engine and transmission units of a helicopter are mounted within the fuselage, means for ready access should be provided in the form of removable panels and doors, and provision should be made for removing the power units through the bottom of the fuselage or the side or by hoisting from above. Three methods are suggested for designing antitorque shafting for the greatest accessibility. Suitable jacking and hoisting points are described, the most practical arrangement calling for the location of these points adjacent to landing-gear hinge points or engine-mount attachment points. Attention is given to the maintenance of the rotor assembly unit, as well as to lubrication and the care of rotor blades. A chart is given for suggested inspection routines. *Aero Digest*, November 1, 1944, pages 96, 100, 139, 4 illus.

Un Nuevo de Helicoptero—El Avion Rotor Cameron (A New Type of Helicopter—The Cameron Rotating Wing Aircraft). B. Forde. It is stated that a new type of rotating wing aircraft has been designed by an inventor identified only as Father Cameron. Designed to combine the outstanding features of the airplane and the helicopter, its characteristics include retractable rotor blades and wings with variable angles of incidence. Cameron's special retraction method decreases the diameter of the rotor blades from 74 ft., when fully extended to 40 ft. when retracted. At cruising speed the blades are partially retracted to decrease the resistance of the rotor.

During normal flight the wings are brought into the position of conventional airplane wings. Level flight speed of this aircraft is obtained by means of two auxiliary propellers, mounted on the entering edge of the wings. These propellers also assist in the ascent or descent of the machine.

It is reported that the Cameron rotating wing aircraft may be used (1) as a regular helicopter when the rotor blades are fully extended and the wings are in a vertical position; (2) as a gyroplane when the rotor blades are partially extended and the wings are in a position similar to conventional airplane wings; or (3) as a gyroplane with the rotor blades retracted and actuated only by the force of the air, while the horizontal wings carry the weight of the machine and propulsion is supplied by the action of the auxiliary propellers. *Aeronautica (Chile)*, September, 1944, pages 40, 41, 3 illus.

Principles of the Helicopter. Alexander Klemin. A review of the fundamentals of helicopter construction and operation. The following requirements of the helicopter are examined: (1) ability to rise vertically; (2) ability to hover; (3) ability to descend vertically with power on; (4) ability to descend vertically without power; (5) rate of climb on an inclined path; (6) equalization of lift and speed in forward flight; (7) reasonable useful load; (8) stability in hovering and vertical climb. The study also extends to: (9) control and maneuverability; (10) control mechanism; (11) vibration; (12) structural requirements; (13) power-plant requirements; (14) taking up engine torque; (15) requirements similar to those for the airplane. *Aero Digest*, November 15, 1944, pages 78, 79, 230, 232, 234, 237, 238, 5 illus.

Stress Analysis

Photo-Elastic Stress Patterns. J. G. Strong. General notes on the interpretation of photoelastic patterns, written for those not acquainted with the subject, are given. The manner in which photoelastic patterns are produced is briefly explained. The writer then describes the formation of basic patterns in sections devoted to bending, compression, tension, and shear. The effect of holes in load-carrying members is discussed. Consideration is given to more complex patterns. *Aircraft Engineering*, October, 1944, pages 278–280, 6 illus.

Dyadic Analysis of Space Rigid Framework. Chen Pei-Ping. It is demonstrated that a space framework consisting of prismatic beams and rigid joints may be analyzed exactly by solving a set of simultaneous linear vector equations with dyadic coefficients. The iteration method may be applied equally well. After setting forth the general rules and other assumptions by which the discussion is limited, the writer develops a fundamental vector equation for a beam, giving examples of two special cases in which (1) the end is hinged and (2) the end is slotted. An externally hinged rigid joint and an externally slotted rigid joint are studied and examples are given of the equivalent load system and equivalent dyadics. The direct method and the iteration method are explained with accompanying mathematics. *Journal of the Franklin Institute*, November, 1944, pages 325–334, 6 illus.

Analysis of Continuous Beams Having Variable Moments of Inertia. Donald A. DuPlantier. The writer discusses the application of modifications of the theorem of three moments for those occasions in the design of aircraft structures when it becomes necessary to analyze a continuous beam whose moment of inertia varies within each span. It is noted that only approximate results are obtained by the procedure frequently used for such cases and that errors caused by unknown and unpredictable factors can exceed 20 per cent. In its generalized form the modified equation can be used to analyze any continuous beam, once the continuous-beam factors have been determined.

A comparison is made of the conventional form of the theorem, involving a constant moment of inertia, with the general form involving a varying moment. The modulus of elasticity is assumed to be constant in all cases. Five cases are considered with a mathematical solution of each as follows: (1) uniformly distributed load; (2) uniformly varying load, varying uniformly from zero at the outer support to maximum at the inner support; (3) uniformly varying load, varying uniformly from maximum at the outer support to zero at the inner support; (4) concentrated loads; (5) yielding supports. The first two cases are developed for conditions involving constant and varying moments of inertia. Continuous-beam factors are considered and their equations are listed in an appendix, but the method for determining the numerical values from logarithmic graphs is explained in the text. Illustrative problems are worked out and their solutions are given according to the approximate method and the exact method. *Aviation*, November, 1944, pages 137, 138, 297, 299–301, 8 illus.

Testing

Testing Oil Tanks for Air Entrainment Characteristics. Part I. G. S. Peterson and B. R. Walsh. The first of a series of three articles describes a

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method of testing aircraft oil tanks to determine air entrainment characteristics and gives some typical results as affected by oil-flow rate, oil temperature, and oil-tank level. The method of testing tanks was developed by the Gulf Research & Development Company as a result of the Wright Aeronautical Corporation's presentation of the need for investigating oil tanks in connection with the problem of obtaining satisfactory operation of lubrication systems at high altitude. *Industrial Aviation*, November, 1944, pages 42–44, 46, 77, 8 illus.

Fatigue-Testing Methods and Equipment. H. W. Foster and Victor Seliger. Important considerations in fatigue testing are discussed, and the advantages and limitations of some of the more widely used methods are examined. A description is given of the subresonance fatigue-testing technique and apparatus developed and used by Lockheed Aircraft Corporation. Sections of the article deal with the general methods of fatigue testing, Lockheed fatigue machines, four basic methods of dynamic load control, and typical test results. *Mechanical Engineering*, November, 1944, pages 719–725, 17 illus.; "Resonant Fatigue Tests," *Industrial Aviation*, November, 1944, pages 31, 74, 2 illus.

Crushing Design Data for 24ST Tubing. A. B. Pontius. Information is given regarding tests to determine allowable crushing stresses on 24ST tubing, conducted by Boeing Aircraft Company as a part of a test program to determine the stress allowable in various types of materials. Drawings show the way in which the test specimens were assembled and fabricated. Curves show the recommended allowable crushing stresses and the column allowable stresses. *Automotive and Aviation Industries*, November 15, 1944, pages 22, 23, 6 illus.

Testing of Exhaust Heat Exchangers. Paul A. Pitt. The twofold purpose of testing exhaust heat exchangers is defined as determining thermodynamic characteristics and basic structural weaknesses of the unit over a wide latitude of conditions prevailing during the normal operation of the airplane. Laboratory tests are compared with flight tests. The advantages of laboratory testing are outlined as: availability of proper exhaust flows, exhaust temperatures, and service conditions; unrestricted instrumentation; convenience of adjustment; control of exhaust and ventilating air; and the opportunity for other miscellaneous tests. Recommendations are made for detailed test procedure. Causes for the failure of heat exchangers are summarized; these include thermal stresses, poor flow distribution, high core temperatures, vibration, and corrosion. *Aero Digest*, November 1, 1944, pages 102, 105, 126, 129, 3 illus.

Testing Equipment

Electric Panel Speeds Engineering Tests. E. R. Siefkin. This article deals with the electrical panel devised by Lockheed Aircraft Corporation for the testing of aircraft electrical equipment to ascertain whether new products are equal or inferior in performance and weight to currently used items or whether they warrant more exhaustive tests to establish conclusively their performance advantages and possible idiosyncracies. The panel also provides means for checking current consumption, operation, etc., on unlabeled apparatus and for locating the cause of failure or faulty functioning in electrical equipment. The unit consists of six subpanels, each of the standard 7- by 19-in. rack size on which are located connection jacks. Connections between the various meters, resistors, etc., desired in the test circuit are made by means of patch cords fitted with plugs on both ends. Alternating-current power at 110 volts, 60-cycle power, and 30-volt, d.c. power are fed in from the back of the panel and terminate in jacks on the a.c. and the d.c. power panels, respectively. A brief description of each of the subpanels and its uses is given. *Aero Digest*, November, 1944, pages 106, 238, 1 illus.

Tools and Equipment

Aerotool Metrology. Part II. H. Grafton. Adapted from a paper read before the Institution of Production Engineers, this is the concluding half of a two-part article on the science and means of measuring tools required for the manufacture of large aircraft components. It describes in detail the application of optical measurement to the manufacture and inspection of large assembly equipment. It is concerned particularly with explaining the principles, operation, application, and high-precision results of meteorology triangulation. This is defined as a system developed by the writer, based upon the methods of the surveyor, for the optical length-measurement of equipment used by the mechanical engineer. It also discusses six fundamental setups that can be used for calibrating the position of the instrument. These include: single-station calibration by three-point observation; single-station calibration in which the position of the horizontal-circle zero of the theodolite is determined by using a pentag prism; single-station calibration by the autocollimation method; dual-station calibration, making use of the swiveling subtense bar; dual-station calibration in which use is made of a length standard and two-point observation; and a method of dual-station calibration employing the length standard but based on three-point, instead of two-point, observation. The results achieved and the margin of error are discussed. *Aircraft Production*, November, 1944, pages 542–547, 11 illus.

The Fairey "Benfold" Forming Machine. A machine for producing curved drawn sections, which is produced by the Fairey Aviation Company, is described. It is explained that members so made may be used in main component assemblies without further manipulation. The member can be produced with a profile of either constant or varying radius. Typical components that can be manufactured include nose-rib booms, fore and aft wing stiffeners, bulkhead flanges, formers for monocoques, and ribs for floats. *Aircraft Engineering*, October, 1944, page 306, 4 illus.

ATSC Tools Save Time, Equipment. Several tools devised by Air Transport Service Command mechanics for the quicker and more efficient maintenance of Army planes are described. The tools include a device for removing propeller shaft thrust nuts without sledge hammers; a guide that prevents the slipping of the propeller-hub retaining-nut wrench; a time-saving jig for bending cowling safety pins; a clamp for holding Cannon plugs while they are being wired, which helps to prevent damaging of the plug; a vise-operated cable clamp for bending heavy cable and holding it firmly while being clipped; a screw-loosener that removes screws without damaging the holes; and a stand for repairing circular radiators. *Aviation*, November, 1944, pages 156–158, 7 illus.

Training

Canada Sets Up Beam-Approach Flight School. James Montagnes. This article deals with the R.C.A.F. beam-approach training school at Deseronto, Ontario. Besides giving some brief information about the background, functions, equipment, and methods of the school, it tells how the beam-approach system works and what the training courses encompass. The new training school is claimed by the R.C.A.F. to be the only school among the Allied air forces to combine at one station courses in beam approach, beam-approach technical training, and Link trainer. It is also the first instrument-flying training school established by the R.C.A.F. in Canada. *Aviation*, November, 1944, pages 187, 188, 276, 4 illus.

Warfare

Flying-Bomb Launching Ramps. Illustrations show the design of a ramp used for launching German flying bombs. The features of the ramp, as disclosed by the photographs, are discussed. The ramp consists of a tube having a longitudinal slot in its upper surface and provided with a flat trackway edged by guard rails. The ramp slopes upward for about four-fifths of its length and then dips sharply beyond what is evidently the disengaging point. *Engineering*, September 22, 1944, pages 237, 238, 3 illus.

Welding

Radiography for Development and Control of Aluminum Alloy Spot Welding. G. W. Scott, Jr., L. G. Sutton, and J. H. Widmyer. Details

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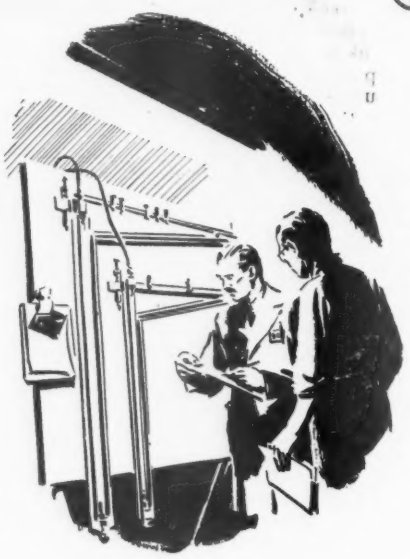

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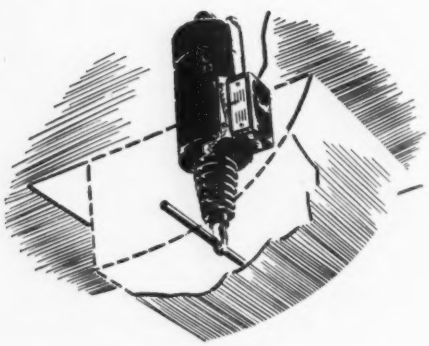

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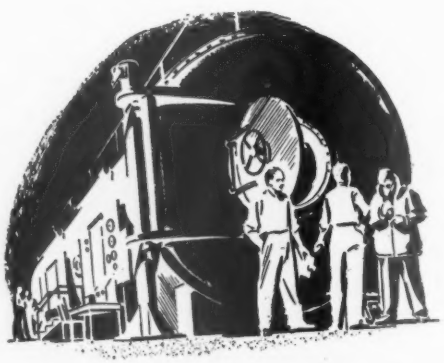

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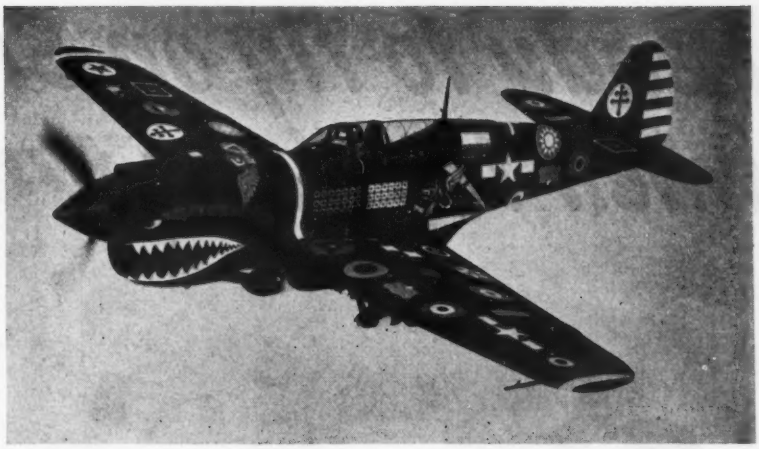
are given about a program of spot-weld radiography which has been an important and constructive part of a system of quality control for spot welds in aircraft subassemblies, including an unusually large percentage of welds in primary structures. It is stated that over a period of 18 months at least 50,000 aluminum-alloy spot welds were radiographed and the negatives studied. From a study of this collection, it was possible to: (1) determine the optimum procedure and equipment for rapid, routine spot-weld radiography of 24-ST Alclad and 61-SW alloys; (2) reveal and correlate with macrographs of cross sections many interesting and instructive structural features of welds in these alloys; (3) identify weld defects, such as internal cracks, porosity, slug asymmetry, spits, cladding inclusions, and duds, which are not otherwise evident from nondestructive tests; (4) establish allowable limits for these radiographic defects in production welding which are commensurate with the known influence of the defects on weld strength and with normal factory operating conditions for preweld cleaning and spot welding. Sections of the article are devoted to a description of the apparatus and radiographic technique, the use of radiography to reveal spot-weld structure, and the use of radiography for the development and control of the spot-weld process. The conclusions drawn from the study are summarized. *The Welding Journal*, November, 1944, pages 560-s–570-s, 20 illus.

Flash Welding in Airframe Design. H. J. Malee. Adverse factors are discussed which reacted against the adaptation of flash welding in air-frame production prior to the war but which have since been eliminated or reduced. It is stated that, while design conversion has progressed at a satisfactory rate, many aircraft components that could be adopted to the flash-weld process are still being laboriously fusion-welded or forged. Seven advantages that will be realized when a part can be designed for flash welding, rather than by fusion welding or forging, are listed. To aid in elucidating certain obscure advantages that are inherently a part of the flash-welding process, a brief outline is given of the theory of flash welding. The specific advantages are then discussed. *Industrial Aviation*, November, 1944, pages 50–52, 54, 72, 73, 9 illus.

The Technique of Resistance Welding. R. Bushell. Spot-welding processes are reviewed in this article, a considerable portion of which is devoted to the spot welding of mild steel. This subject is dealt with in sections discussing spot-welded mild steel sheet, the energy required to make a weld, weld timers, and multihead spot-welding machines. Tables contain data for spot-welding mild steel sheet, recommendations for electrode tip diameters, the names of the principal alloys for spot-welding electrodes, and test results of joints between unequal thicknesses of mild steel sheet. The latter part of the article discusses the spot welding of alloy steels, brass, silicon bronze, aluminum, and aluminum alloys. *Sheet Metal Industries*, October, 1944, pages 1793–1803, 19 illus.



The 15,000th Curtiss fighter completed at Curtiss-Wright Corporation's Buffalo plant, November 22, 1944. The insignia on the wings and fuselage represent the following air forces with which Curtiss fighters have served during this war in addition to the U.S. Army Air Forces: Great Britain, Russia, China, France, Norway, Canada, Chile, Bolivia, Argentina, Poland, Portugal, Cuba, the Netherlands, Netherlands East Indies, Nicaragua, Colombia, Turkey, Brazil, Iran, Guatemala, Thailand, Peru, Australia, New Zealand, South Africa, the Free French, and the American Volunteer Group (Flying Tigers).

Miscellaneous

Directory of Western Parts Manufacturers and Processors. This is an alphabetical listing of companies engaged in or available for subcontracting to Western aircraft manufacturers. It includes the name and address of each company, the services offered, and the names of its president, manager, or owner. *Western Flying*, October, 1944, pages 236, 238, 240, 243, 244, 246, 248, 250, 252, 254, 256, 258, 262, 264, 266, 268, 270, 272, 274, 276, 278, 280, 282, 284.

Research for Preparedness. R. E. Gillmor and Major Gen. Follett Bradley (Retired). It is stated that the relationship of research to the quantity production of supplies for war is not so well understood as the more widely publicized contributions of the war industries. To provide a better understanding of research and its relation to the armed forces, the President of Sperry Gyroscope Company, Inc., and the former commander of the First Air Force, now Assistant to the President of the Sperry company, review the procedure within the Army Air Forces for procuring a certain piece of equipment. They take the computing gun sight as an example and explain how it was developed. Various aspects of research for future preparedness are then discussed. *U. S. Air Services*, November, 1944, pages 13, 14, 54.

Research-Results. Keith Edgar. A survey of aeronautical developments sponsored by Canada's National Research Council Laboratory at Rockcliffe, together with details about the equipment with which the research is conducted. Information is also given relative to the functions, organization operating methods, and "fees" of the Laboratory. Descriptions refer to the Council's spinning tunnel, instrument section, chemical laboratories, horizontal wind tunnel, workshop for building models and experimental projects, hydrodynamic laboratory, engine-testing laboratory, structures laboratory, and facilities for static tests on aircraft components. *Canadian Aviation*, November, 1944, pages 68–70, 122, 123, 17 illus.

Warning Given on Misuse of "Sodium" Valves. This brief article warns mechanics against cutting or otherwise tampering with sodium-filled exhaust valves. It is explained that injury may result from loose sodium that combines with air moisture to form hydrogen gas, which is highly inflammable. *Automotive News*, November 13, 1944, page 60.

The Aeronautical Museum. M. J. B. Davy. The function of an aeronautical museum in education and culture is discussed. It is stated that, expressed in simplest terms, the aeronautical museum should show how the art of human flight was and is developed and how the faculty of flight was and is used, since these two aspects comprise the whole of aeronautics. The classification and arrangement of an aeronautical museum is outlined, and consideration is given to the method of display. To amplify the purpose and method of an aeronautical museum, a description is given of two collections in Europe, which, it is stated, are perhaps less known than those in London and Washington. These are the Musée de l'Air, Paris, and the aeronautical collection in the Deutsches Museum, Munich. *Aircraft Engineering*, October, 1944, pages 290–292.

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Source Material

For the information of readers, the following lists the periodicals, house organs, and other publications regularly received and reviewed.

The prices listed are for single issues and yearly subscriptions to recipients in the United States. Subscription prices to house organs are in many cases not available but may be obtained directly from the offices of the organization.

The frequency of publication is indicated by the following symbols: M, monthly; SM, semimonthly; BM, bimonthly; W, weekly; BW, biweekly; D, daily; Irreg., irregularly; Q, quarterly.

The AAFSATONIAN, School of Applied Tactics, Army Air Forces, Orlando, Fla., W.

Accelerator, Metropolitan Section, Society of Automotive Engineers, 29 W. 39th St., New York 18, N.Y., 10 issues per yr.

The Ace-Pursuiter, Special Service Office, Paine Field, Everett, Wash., SM.

Aero, Aero Division, Minneapolis-Honeywell Regulator Co., 2753 4th Ave. S., Minneapolis 8, Minn., M.

Aero Digest, 515 Madison Ave., New York 22, N.Y., SM, $0.50, $3.00.

The Aero Field, Francis J. Field, Ltd., Sutton Coldfield, England, 10 issues per year, 6*d*., 5*s*.

Aero News Letter, Aero Insurance Underwriters, 111 John St., New York 7, N.Y., BM.

Aero Products, 271 Madison Ave., New York 16, N.Y., M.

Aero Research Technical Notes, Aero Research, Ltd., Duxford, Cambridge, England, M.

Aero Time, Basic Flying School, Army Air Forces, Gunter Field, Ala., W.

Aerodome Abstracts, compiled by the Department of Scientific and Industrial Research and issued in collaboration with the Air Ministry, The Institution of Civil Engineers, St. George St., Westminster, London, S.W.1, M.

Aeronáutica, Avda. de Mayo 1370, Buenos Aires, M, $0.60 (pesos), $4.50 (pesos).

Aeronáutica, Clasificador F-468, Santiago de Chile, M, $6.00 (pesos), $50.00 (pesos).

Aeronautical Briefs, Aeronautical Chamber of Commerce of America, Inc., 610 Shoreham Bldg., Washington 5, D.C., M.

Aeronautical Chamber of Commerce of America, Inc., Weekly Washington Bulletin, 610 Shoreham Bldg., Washington 5, D.C., W.

Aeronautical Engineering Review, 1505 RCA Bldg. West, 30 Rockefeller Plaza, New York 20, N.Y., M, $0.30, $3.00.

Aeronautics, Tower House, Southampton St., Strand, London, W.C.2, M, 2*s*., 26*s*. 6*d*.

The Aeroplane, Bowling Green Lane, London, E.C.1, W, 1*s*., 58*s*.

The Aeroplane Spotter, Bowling Green Lane London, E.C.1, BW, 3*d*., 8*s*. 8*d*.

Air Age Education News, Air Age Education Research, 100 E. 42d St., New York 17, N.Y., BM.

Air Base News, Army Air Base, Jackson, Miss., W.

The Air Box, Chandler-Evans Corp., So. Meriden, Conn., BM.

Air Currents, Army Air Field, Coffeyville, Kan., W.

Air Facts, 30 Rockefeller Plaza, New York 20, N.Y., M, $0.25, $3.00.

Air Force, Army Air Forces, 101 Park Ave., New York 17, N.Y., M.

The Air Line Mechanic, 155 N. Clark St., Chicago 1, Ill., M.

The Air Line Pilot, 3145 W. 63d St., Chicago 29, Ill., M.

Air Mail Magazine, A. Phillips, Newport, Monmouthshire, M, 4*d*., 5*s*.

Air News, 545 5th Ave., New York 17, N.Y., M, $0.20, $2.00.

Air Pilot and Technician, 515 Madison Avenue, New York 22, N.Y., M, $0.35, $3.00.

Air Tech, 545 5th Ave., New York 17, N.Y., M, $0.25, $2.50.

Air Trails Pictorial, 122 E. 42d St., New York 17, N.Y., M, $0.25, $2.50.

Air Transport, 330 W. 42d St., New York 18, N.Y., M, $0.50, $5.00.

Air Transportation, 10 Bridge St., New York 4, N.Y., M, $0.50, $5.00.

Air World, 241 Church St., New York 13, N.Y., BM, $0.15, $0.90.

Aircraft, 62 Flinders St., Melbourne, C.1, M, 1*s*. per issue.

Aircraft Engineering, 12 Bloomsbury Sq., London, W.C.1, M, 2*s*. 3*d*., 26*s*.

Aircraft Production, Dorset House, Stamford St., London, S.E.1, M, 2*s*. 6*d*., £1 14*s*. 6*d*.

The Aircraft Warning Volunteer, First Fighter Command, Army Air Forces, Mitchel Field, N.Y., M.

The AiResearcher, AiResearch Mfg. Co., Sepulveda Blvd., Los Angeles, Calif., M.

Airflow, Academy of Aeronautics, Jackson Heights, L.I., N.Y., and Casey Jones School of Aeronautics, Newark, N.J., M.

Airlanes, 340 W. 57th St., New York 19, N.Y., M, $0.25, $2.50.

Air-O-Mech, Army Air Forces, Seymour Johnson Field, N.C., W.

Airports, 1170 Broadway, New York 1, N.Y., M, $0.25, $3.00.

Airpost Journal, American Air Mail Society, Albion, Pa., M, $0.20, $2.00.

The Air-Scoop, Army Air Base, Pueblo, Colo., W.

Alamogordo Blockbuster, Army Air Base, Alamogordo, N.M., W.

Allisonews, Allison Division, General Motors Corp., Indianapolis, Ind., SM.

Aluminum and Magnesium, 133 W. 21st St., New York 11, N.Y., M, $3.00 yr.

Aluminum News Letter, Aluminum Co. of America, Pittsburgh 19, Pa., M.

AM, Army Air Field, Lincoln, Neb., W.

American Aviation, American Bldg., Washington 4, D.C., SM, $0.25, $4.00.

American Aviation Daily, American Bldg., Washington 4, D.C., D, $170.00 yr.

American Aviation Directory, American Bldg., Washington 4, D.C., semi-annually, $5.00, $7.50.

American Aviation Traffic Guide, 139 N. Clark St., Chicago 2, Ill., M, $0.50, $5.00.

American Helicopter Society, Semi-Technical Bulletin, Newfield P.O. Box 4029, Bridgeport 7, Conn., Irreg., $0.50 per issue.

The American Mercury, 570 Lexington Ave., New York 22, N.Y., M, $0.25, $3.00.

American Meteorological Society, Bulletin, Milton, Mass., M, $0.35, $3.50.

American Society for Testing Materials, Bulletin, 260 S. Broad St., Philadelphia 2, Pa., BM, $0.25, $1.50.

American Society of Mechanical Engineers, Transactions, 29 W. 39th St., New York 18, N.Y., M, $1.50, $12.00.

Anahuac, Calle 21 Núm. 500 Col. Moctezuma, México, D.F., M, $0.25 Mex., $3.00 Mex.

Army Life, Recruiting Publicity Bureau, U.S. Army, Governors Island, N.Y., M.

Army News, Bureau of Public Relations, War Dept., Washington 25, D.C., SM.

Army Ordnance, Army Ordnance Assn., 705 Mills Bldg., Washington 6, D.C., BM, $0.75, $4.50.

Astro-Jet, Glendale Rocket Society, 3262 Castera Ave., Glendale 8, Calif., 3 issues per yr., $1.00 yr.

Astronautics, American Rocket Society, 130 W. 42d St., New York, N.Y., Irreg., $3.00 yr.

Australia, Council for Aeronautics, Reports, Box 4331, G.P.O., Melbourne, Irreg.

Automotive and Aviation Industries, Chestnut & 56th Sts., Philadelphia 22, Pa., SM, $0.25, $1.00.

Automotive News, 5229 Cass Ave., Detroit 2, Mich., W, $0.15, $4.00.

Automotive War Production, Automotive Council for War Production, New Center Bldg., Detroit 2, Mich., M.

Avia, Victoria 788, Buenos Aires, M, $0.50 (*m/n*), $5.00 (*m/n*).

Aviação, Rua Uruguiana, 104, Rio de Janeiro, M, $4.00 (cruzeiros), $40.00 (cruzeiros).

Aviation, 330 W. 42d St., New York 18, N.Y., M, $0.50, $3.00.

Aviation and Yachting, 2816 Eaton Tower, Detroit 26, Mich., M, $0.25, $2.00.

Aviation Equipment, 1170 Broadway, New York 1, N.Y., M.

Aviation Maintenance, 205 E. 42d St., New York 17, N.Y., M, $0.50, $5.00.

Aviation News, 330 W. 42d St., New York 18, N.Y., W, $0.50, $5.00.

Aviation Progress, County Chamber of Commerce, Los Angeles, Calif., M.

Aviation Review, 31 Willcocks St., Toronto 5, Ontario, M, $0.25, $3.00.

Aviation Service Magazine, 549 W. Washington Blvd., Chicago 6, Ill., BM.

Aviation Writers Assn., Newsletter, P.O. Box 856, Grand Central Annex, New York 17, N.Y., Irreg.

Bakelite Review, Union Carbide and Carbon Corp., 30 E. 42d St., New York 17, N.Y., Q.

Ballardair, The Walter M. Ballard Corp., 331 Madison Ave., New York 17, N.Y., M.

Barksdale's Bark, Army Air Forces, Barksdale Field, La., W.

The Beach Post, Training Center No. 1, Army Air Forces, Miami Beach, Fla., W.

The Beam, Basic Training Center, Army Air Forces, Fresno, Calif., W.

The Beam, Pilot School (Advanced Single Engine), Army Air Forces, Army Air Field, Marianna, Fla., W.

The Beam, Special Service Office, Army Air Forces, Bolling Field, D.C., SM.

The Beech Log, Beech Aircraft Corp., Wichita, Kan., W.

The Bee-Hive, United Aircraft Corp., East Hartford, Conn., BM.

Bell Aircraft News, Bell Aircraft Corp., Buffalo, N.Y., W.

Bell Aircraft News, Bell Aircraft Corp., Marietta Ga., W.

Bell Laboratories Record, 463 West St., New York 14, N.Y., M, $2.00 yr.

The Bell Ordnance News, Bell Aircraft Corp., Burlington, Vt., W.

The Bellringer, Bell Aircraft Corp., 2050 Elmwood Ave., Buffalo, N.Y., M.

Bendix Communiqué, Philadelphia Div., Bendix Aviation Corp., 4700 Wissahickon Ave., Philadelphia 44, Pa., M.

Bendix Radio Engineer, Bendix Radio Div., Bendix Aviation Corp., Baltimore 4, Md., Q, $2.00 yr.

Biggstuff, Army Air Forces, Biggs Field, Tex., W.

Black Landmarks, Blackland Army Air Field, Waco, Tex., W.

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Bladesman, Propeller Div., Curtiss-Wright Corp., Caldwell, N.J., Irreg.

The B-Liner, Braniff Airways, Inc., Dallas 9, Tex., M.

The Block Buster, Army Air Field, Gulfport, Kan., M.

Boeing Plane Talk, Boeing Airplane Co., Wichita, Kan., W.

Boeing Contact, Boeing Airplane Co., Wichita, Kan., M.

Boeing Magazine, Boeing Aircraft Co., Seattle, Wash., M.

The Bomb Bay, Army Air Forces, Hammer Field, Fresno, Calif., W, $2.00 yr.

Bomb Blast, Army Air Field, Childress, Tex., W.

Bombing Range High Score, Army Air Forces, Avon Park, Fla., W.

Bombs Away, Army Air Field, Victorville, Calif., SM.

The Bombsight, Advanced Flying School, Army Air Forces, Kirtland Field, N.M., W.

Booster, Pilot School (Advanced Single Engine), Army Air Forces, Napier Field, Dothan, Ala., W.

Boot Hill Marauder, Army Air Field, Dodge City, Kan., W.

The Bradley Beam, Army Air Forces, Bradley Field, Conn., W.

Breeze American, Breeze Corporations, Inc., 41 S. 6th St., Newark, N.J., M.

British Airways News Letter, British Overseas Airways Corp., Airways House, London, S.W. 1, M.

Bulaero, Cal-Aero Technical Institute, Glendale, Calif., M.

Bulletin of Technical Data for the Plywood Industry, The Resinous Products & Chemical Co., 222 W. Washington Sq., Philadelphia 5, Pa., Irreg.

Bulletin of War Medicine, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., M, $0.40, $4.65.

British Plastics, Dorset House, Stamford St., London, S.E.1, M, 1*s.* 6*d.*, 20*s.*

The Cactus, Army Air Field, Kingman, Ariz., W.

Caminos del Aire, Pan American Airways, Inc., Bolivar 18, México, D.F., M.

Canadian Air Cadet, 122 Wellington St., Ottawa, Ontario, M, $0.10, $1.00.

Canadian Aviation, 481 University Ave., Toronto 2, Ontario, M, $0.25, $2.00.

Canadian Car Journal, English Edition, Canadian Car & Foundry Co. Ltd., 621 Craig St., West, Montréal, Quebec, M.

CAP News Bulletin, Civil Air Patrol, 500 5th Ave., New York 18, N.Y., W.

The Carrier, Army Air Forces, Bowman Field, Louisville, Ky., W.

Casual Observer, Army Air Field, Lemoore, Calif., W.

Cessquire, Cessna Aircraft Co., Wichita, Kan., M.

The Chance Vought News, Chance Vought Aircraft Div., United Aircraft Corp., Stratford, Conn., SM.

Chicago Douglas Airview News, Douglas Aircraft Co., Inc., Park Ridge, Ill., W.

Chirp, The Early Birds, c/o Lt. Col. Ernest Jones, Secretary, 3401 16th St., N.W., Washington, D.C., Irreg.

Circle-News, The B. F. Goodrich Co., 500 S. Main St., Akron 11, Ohio, W.

Civil Aeronautics Journal, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.05, $0.50.

Classroom Clipper, Pan American Airways, Inc., 135 E. 42d St., New York 17, N.Y., M.

Cockpit Clatter, Aircraft Owners and Pilots Assn., 1003 K St., N.W., Washington 1, D.C., BM.

Collier's, The Crowell-Collier Publishing Co., Springfield, Ohio, W, $0.10, $3.00.

The Comet, Ampco Metal, Inc., Milwaukee 4, Wis., M.

Command Post, Air Service Command, McClellan Field, Sacramento, Calif., W.

Commercial Aviation, 341 Church St., Toronto, Ontario, M, $0.25, $3.00.

Conference of International Air Traffic Operators, Bulletin, 31-32, Haymarket, London, S.W.1, M, 1*s.*, 10*s.* 6*d.*

The Connecting Link, Link Aviation Devices, Inc., Binghamton, N.Y., BM.

Construction Glues, I. F. Laucks, Inc., 911 Western Ave., Seattle, Wash., BM.

Contact, 113 W. 42d St., New York 18, N.Y., M, $0.20, $2.00.

The Continental Eagle, Continental Air Lines, Inc., Municipal Airport, Denver, Colo., M.

Convair News, Consolidated Vultee Aircraft Corp., Miami, Fla., W.

Craig Field Journal, Pilot School (Advanced Single Engine), Army Air Forces, Craig Field, Selma, Ala., W.

Current Aviation, 400 S. Front St., Columbus 15, Ohio, W, $0.80 yr.

Curtiss Fly-Leaf, Airplane Div., Curtiss-Wright Corp., Municipal Airport, Buffalo, N.Y., BM.

Curtiss Wright-er, Curtiss-Wright Corp., Lambert Field, St. Louis, Mo., W.

D and W, 100 E. 42d St., New York 17, N.Y., M, $0.30, $3.00.

Daggett Douglas Airview News, Douglas Aircraft Co., Inc., Daggett, Calif., W.

The Dalhart Bomber, Army Air Base, Dalhart, Tex., W.

Del Valle News, Bergstrom Army Air Field, Austin, Tex., W.

De Havilland Mosquito, De Havilland Aircraft of Canada, Ltd., Postal Sta. L., Toronto, Ontario, M.

The Department of State Bulletin, U.S. Govt. Printing Office, Washington 25, D.C., W, $0.10, $2.75.

Diesel Power & Diesel Transportation, 192 Lexington Ave., New York 16, N.Y., M, $0.35, $3.00.

Domestic Commerce, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.10, $1.00.

Douglas Airview, Douglas Aircraft Co., Inc., Santa Monica, Calif., M.

Dow Diamond, The Dow Chemical Co., Midland, Mich., BM.

The Draftsman, 171 Madison Ave., New York 16, N.Y., M, $0.25, $3.00.

The Dragon, The Fafnir Bearing Co., New Britain, Conn., M.

Drew Field Echoes, Army Air Base, Drew Field, Tampa, Fla., W.

The Eagle, Consolidated Vultee Aircraft Corp., Ft. Worth, Tex., W.

The Eagle Eye, Eagle Pass Army Air Field, Eagle Pass, Tex., W.

Eastern Aircraftsman, Eastern Aircraft Div., General Motors Corp., Linden, N.J., M.

Edo Log, Edo Aircraft Corp., College Point, L.I., N.Y., M.

The Educational Focus, Bausch & Lomb Optical Co., Rochester, N.Y., Q.

El Segundo Douglas Airview News, Douglas Aircraft Co., Inc., El Segundo, Calif., W.

Electrical Communication, International Standard Electric Corp., 67 Broad St., New York, N.Y., Q. $0.75, $3.00.

Electrical Engineering, 33 W. 39th St., New York 18, N.Y., M., $1.50, $12.00.

EMCO Monthly Journal, Marks Stamp Co., Ltd., 258 College St., Toronto 2, Ontario, M, $0.50 yr.

The Engineer, 28 Essex St., Strand, London, W.C.2, W, 1*s.*, £3 3*s.*

Engineering, 35 Bedford St., Strand, London, W.C.2, W, 1*s.* 2½*d.*, £3 3*s.*

Engineering News-Record, 330 W. 42d St., New York 18, N.Y., W, $5.00 yr.

The Engineers' Digest (American Edition), 1 Madison Ave., New York 10, N.Y., M, $0.75, $7.50.

Enid Plane Facts, Enid Army Flying School, Enid, Okla., W.

Ethyl News, Ethyl Corp., 405 Lexington Ave., New York 17, N.Y., M.

The Exchangite, The National Exchange Club, 335 Superior St., Toledo 4, Ohio, M.

FAD, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp., Hagerstown, Md., BW.

Fairchild News, Fairchild Camera and Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N.Y., M.

The Faircrafters, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp., Burlington, N.C., W.

Faraday Society, Transactions, 98 Great Russell Street, London, W.C.1, M, 5*s.* per issue.

Fasteners, American Institute of Bolt, Nut, and Rivet Manufacturers, 1550 Hanna Bldg., Cleveland 15, Ohio, Q.

The Fighter Pilot, Army Air Field, Pocatello, Idaho, W.

Flagship News, American Airlines, Inc., 100 E. 42d St., New York 17, BM.

Fleetwings Arrow, Fleetwings Div., Kaiser Cargo Inc., Bristol, Pa., M.

Flexigun, Flexible Gunnery School, Army Air Forces, Ft. Myers, Fla., M.

Flight, Dorset House, Stamford St., London, S.E.1, W, 1*s.*, £3 1*s.*

Flight Control, Bendix Aviation Corp., Teterboro, N.J., M.

The Flight Pattern, Army Air Field, Douglas, Ariz., SM.

Flight Time, Basic Pilot School, Army Air Forces, Goodfellow Field, Tex., W.

Flyer, Army Air Base, Reno, Nev., W.

The Flyer, Army Air Field, Chico, Calif., W.

Flying, 540 N. Michigan Ave., Chicago 11, Ill., M, $0.35, $4.00.

Flying Aces, 67 W. 44th St., New York 18, N.Y., M, $0.15, $1.80.

The Flying M, Menasco Mfg. Co., Burbank, Calif., BW.

Flying Time, Pilot School (Basic), Army Air Forces, Pecos, Tex., W.

Flying Time, South Plains Army Air Field, Lubbock, Tex., W.

For Your Information, National Aeronautic Assn., 1025 Conn. Ave., N.W., Washington 6, D.C., W.

Foreign Commerce Weekly, U.S. Govt. Printing Office, Washington 25, D.C., W, $0.10, $4.50.

Foster Field Fighter, Army Air Forces, Foster Field, Tex., M.

The Foundation, Engineering Society of Detroit, 100 Farnsworth Ave., Detroit, Mich., M.

Franklin Facts, Aircooled Motors Corp., Liverpool Rd., Syracuse 8, N.Y., Irreg.

The Franklin Institute, Journal, Benjamin Franklin Parkway at 20th St., Philadelphia, Pa., M, $0.60, $6.00.

General Aircraft News, London Air Park, Feltham, Middlesex, England, M.

Gliding, 4658 Portage Rd., Kalamazoo 85, Mich., M, $0.25, $3.00.

The Globe Beam, Globe Aircraft Corp., Fort Worth 6, Tex., M.

GM Folks, General Motors Corp., Detroit, Mich., M.

The Grace Log, W. R. Grace & Co., 7 Hanover Sq., New York 5, N.Y., Q.

Gt. Brit., Aeronautical Research Committee, Reports and Memoranda, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., Irreg.

Gt. Brit., Air Ministry, Library, Additions List, The Librarian, Whitehall, London, S.W.1, M.

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Gt. Brit., Ministry of Aircraft Production, Abstracts from the Scientific and Technical Press, and Titles and References of Articles and Papers Selected from Publications (Reviewed by R.T.P. 3), Together with List of Selected Translations, Royal Aeronautical Society, 4, Hamilton Place, London, W.1, M.

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Gt. Brit., Stationery Office, Government Publications, British Information Services, 30 Rockefeller Plaza, New York 20, N.Y., M.

The Greenville Post, Army Air Field, Greenville, Miss., W.

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Grumman Plane News, Grumman Aircraft Engineering Corp., Bethpage, N.Y., W.

Guiberson Guidon, Guiberson Corp., Dallas, Tex., BW.

Hags Howl, Flexible Gunnery School, Army Air Forces, Harlingen, Tex., W.

Hamilton Field Takeoff, Army Air Forces, Hamilton Field, Calif., M.

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The Hecker Michronicle, A. W. Hecker, 1976 E. 66th St., Cleveland, Ohio, M.

The Higgins Aircrafter, Higgins Aircraft, Inc., P.O. Box 32, New Orleans 6, La., W.

Hobart Arc Welding News, The Hobart Bros. Co., Troy, Ohio, Irreg.

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Institute of Transport, Journal, 15 Savoy St., Victoria Embankment, London, W.C.2, Q, 2*s.* 6*d.* per issue.

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Instrumentation, The Brown Instrument Co. Div., Minneapolis-Honeywell Regulator Co., Wayne and Roberts Aves., Philadelphia 44, Pa., BM.

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Kidde Industry, Walter Kidde & Co., Inc., 140 Cedar St., New York 6, N.Y., BM.

The Kinner Log, Kinner Motors, Inc., 635 W. Colorado Blvd., Glendale 4, Calif., M.

The Kollsman Instrument Dial, Kollsman Instrument Div., The Square D Co., 80-08 45th Ave., Elmhurst, L.I., N.Y., M.

Kunststoffe, Edwards Bros., Inc., 300 John St., Ann Arbor, Mich., M, $15.00 yr.

Learavian, Lear Incorporated, Piqua, Ohio, M.

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Light Metals, Bowling Green Lane, London, E.C.4, M, 1*s.* 6*d.*, 20*s.*

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List of Selected United States Government Publications, U.S. Govt. Printing Office, Washington 25, D.C., SM.

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The Lockheed Star, Lockheed Aircraft Corp., Burbank, Calif., W.

Long Beach Douglas Airview News, Douglas Aircraft Co., Inc., Long Beach, Calif., W.

Lubrication, The Texas Co., 135 E. 42d St., New York 17, N.Y., M.

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Lukens Steel Co., Technical Library, Bulletin, 1940 Gillen St., Coatesville, Pa., M.

The Lycoming Star, Lycoming Div., The Aviation Corp., Williamsport, Pa., M.

McDonnell Bulletin, McDonnell Aircraft Corp., Lambert Field, St. Louis, Mo., W.

The M.A.A.F. Cowling, Marana Army Air Field, Tucson, Ariz., SM.

Machine Design, Penton Bldg., Cleveland 13, Ohio, $0.50, $6.00.

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The March Field Beacon, Army Air Forces, March Field, Calif., W.

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Mechanical Engineering, 29 W. 39th St., New York 18, N.Y., M, $0.75, $6.00.

Mechanical Topics, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y., M.

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Metals and Alloys, 330 W. 42d St., New York 18, N.Y., M, $0.25, $2.00.

Metco News, Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City 1, N.Y., BM.

Metropolitan Airmail Cover Club, Bulletin, The Malin Studios, 225 W. 46th St., New York 19, N.Y., M.

The Military Surgeon, Army Medical Museum, Washington 25, D.C., M, $0.50, $4.00.

Model Airplane News, 551 5th Ave., New York 17, N.Y., M, $0.20, $2.00.

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Modern Transport, 105-109, Strand, London, W.C.2, W, 3*d.*, 20*s.*

Monthly Science News, The British Council, 3 Hanover St., London, W.1, M.

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Mundo Aeronáutico, Rivadavia 945, Buenos Aires, M, $0.30 (pesos), $4.00 (pesos).

NAAF News, Army Air Field, Newport, Ark., SM.

The N.A.T.A. Dispatch, National Aviation Trades Assn., 214 E. Armour Blvd., Kansas City 2, Mo., 36 issues per yr.

National Aeronautics, 1025 Conn. Ave., Washington 6, D.C., M, $6.00 yr.

New Horizons, Pan American Airways, Inc., 135 E. 42d St., New York 17, N.Y., M.

New York University, Contributions from the College of Engineering, University Heights, New York 53, N.Y., Irreg.

News, Army Air Field, Presque Isle, Me., W.

News Digest, Hill and Knowlton, 350 5th Ave., New York 1, N.Y., W.

Nickel Cast Iron News, The International Nickel Co., Inc., 67 Wall St., New York 5, N.Y., M.

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North American Skyline, North American Aviation, Inc., Inglewood, Calif., BM.

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Northeast Airlines Gremlin, Northeast Airlines, Inc., 1 State St., Boston, Mass., Q.

The Northeast Airlines Up-to-the-Minute Man, Northeast Airlines, Inc., Commonwealth Airport, Boston, Mass., D.

The Northern Dispatch, Army Air Base, Great Falls, Mont., W.

The Northrop News, Northrop Aircraft, Inc., Northrop Field, Hawthorne, Calif., BW.

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Oscillator, Western Electric Co., 195 Broadway, New York, N.Y., Irreg.

PCA News, Pennsylvania-Central Airlines, Washington National Airport, Washington 25, D.C., M.

Pacific Aeronautical Library, Check-List, 6715 Hollywood Blvd., Los Angeles 28, Calif., Irreg.

Pacific Plastics, 3142 Wilshire Blvd., Los Angeles 5, Calif., M, $0.30, $3.00.

Pan Atlantic News, Atlantic Div., Pan American World Airways, La Guardia Field, New York, N.Y., W.

Parks Air News, Parks Air College, E. St. Louis, Ill., M.

The Pegasus, Fairchild Engine & Airplane Corp., 30 Rockefeller Plaza, New York 20, N.Y., M.

Pesco Pilot, Pesco Products Co. Div., Borg-Warner, 11610 Euclid Ave., Cleveland 6, Ohio, M.

Photogrammetric Engineering, The American Society of Photogrammetry, P.O. Box 18, Benjamin Franklin Sta., Washington, D. C., $1.50 per issue.

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Plane Talk, Consolidated Vultee Aircraft Corp., Room 3301, 350 5th Ave., New York 1, N.Y., M.

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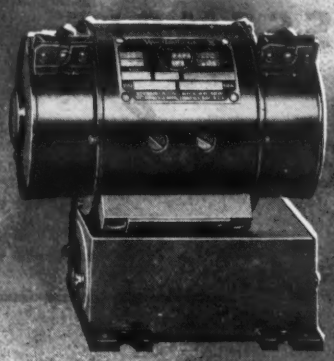

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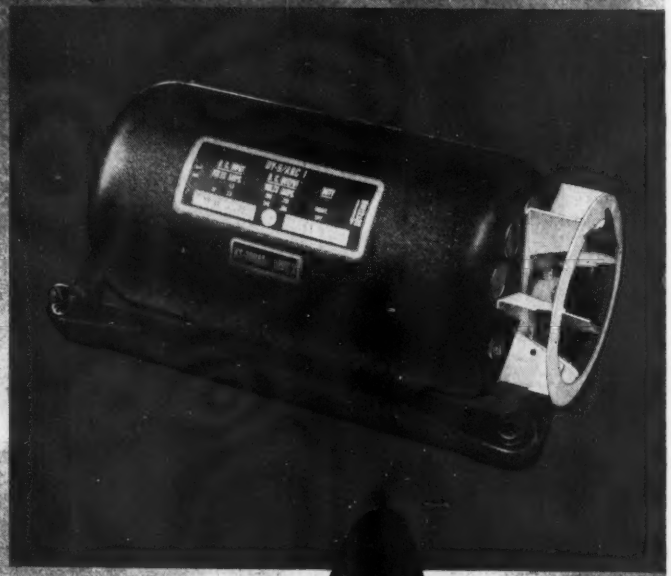

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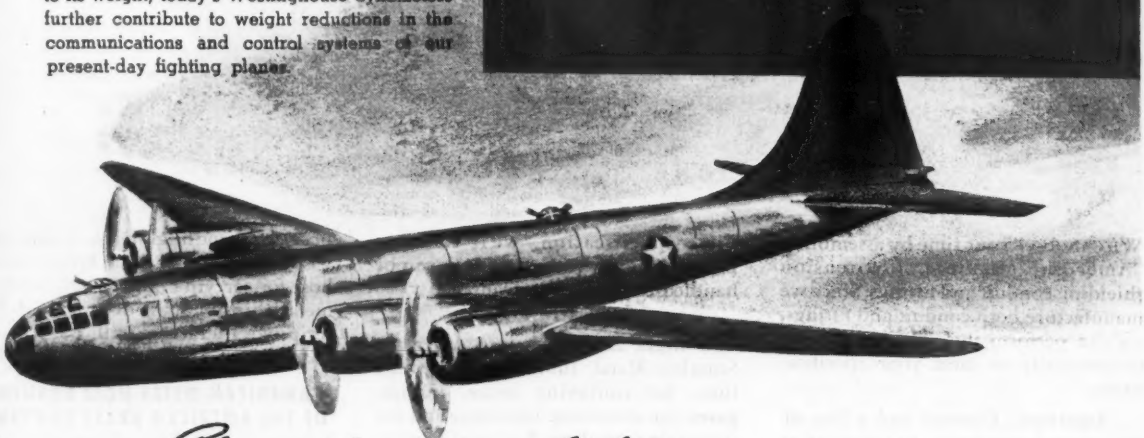

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The Robins Field News-Beacon, Warner Robins Air Service Command, Army Air Forces, Robins Field, Ga., W.

Roger, 6th Ferrying Group, Air Transport Command, Army Air Field, Long Beach, Calif., W.

The Rohm & Haas Reporter, Rohm & Haas Co., 222 W. Washington Sq., Philadelphia 5, Pa., M.

Rotol Digest, Reference Library, Rotol, Ltd., Gloucester, England, W.

Royal Aeronautical Society, Journal, 4, Hamilton Place, London, W.1, M, 5*s*., £3 3*s*.

Royal Meteorological Society, Quarterly Journal, 49, Cromwell Rd., London, S.W.7, Q, 7*s*. 6*d*. per issue.

The Runway, Army Air Forces, Pope Field, Ft. Bragg, N.C., SM.

Runway Review, Army Air Field, McCook, Nebr., W.

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Ryan Flying Reporter, Ryan Aeronautical Co., San Diego, Calif., M.

Ryan Sky News, The Ryan School of Aeronautics, Lindbergh Field, San Diego, Calif., M.

SAE Journal, Society of Automotive Engineers, 29 W. 39th St., New York 18, N.Y., M, $1.00, $10.00.

The Salt Tablet, Army Air Base, Wendover Field, Utah, W.

Salvo, Army Air Base, Roswell, N.M., W.

Sanabria's Airpost News, Nicolas Sanabria, 521 5th Ave., New York 17, N.Y., Q.

Santa Monica Douglas Airview News, Douglas Aircraft Co., Inc., Santa Monica, Calif., W.

Schweizer Aero-Revue, Hirschengraben 22, Zürich, M. 80 Rappen, 10.00 Sw. Fr.

The Saturday Evening Post, Independence Sq., Philadelphia 5, Pa., W, $0.10, $6.00.

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Spartan News, Spartan School of Aeronautics and Spartan Aircraft Co., Municipal Airport, Tulsa, Okla., M.

Speed, Western Air Lines, Inc., 510 W. 6th St., Los Angeles, Calif., M.

The Sperry News, Sperry Gyroscope Co., Manhattan Bridge Plaza, Brooklyn 1, N.Y., SM.

Sperryscope, The Sperry Corp., Manhattan Bridge Plaza, Brooklyn 1, N.Y., Q.

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Steam Car Developments and Steam Aviation, Nestling House, Sleights, Yorkshire, England, Q, 3*s*. per issue.

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The Stinsonair, Stinson Div., Consolidated Vultee Aircraft Corp., Wayne, Mich., BW.

Tac, Tactical Center, Army Air Forces, Orlando, Fla., W.

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Tailspin, Army Air Forces, Ellington Field, Houston, Tex., W.

Take-Off, Farris Publishing Co., Tinker Field, Okla., W.

Take-Off, North American Aviation, Inc., Dallas, Tex., W.

The Tail-Spinner, Army Air Forces Preflight School, San Antonio, Tex., W.

TARFU, Laughlin Army Air Field, Del Rio, Tex., W.

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The Taylorcraft News, Taylorcraft Aviation Corp., Alliance, Ohio, M.

Technical Data Digest, Air Technical Service Command, TSEAL-61, Area B, Wright Field, Ohio, M.

Technical Education News, McGraw-Hill Publishing Co., Inc., 330 W. 42d St., New York 18, N.Y., M.

Technical News Bulletin of the National Bureau of Standards, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.25, $0.50.

The Texaco Star, The Texas Co., 135 E. 42d St., New York 17, N.Y., Q.

Texacts, Army Air Forces Technical School, Sheppard Field, Tex., W.

The Thermal, The Southern California Soaring Assn., Inc., 453 S. Spring St., Los Angeles 13, Calif., M, $2.00 yr.

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Trade-a-Plane Service, Crossville, Tenn., 3 issues per month, $0.25 yr.

Transatlantic Air News, American Export Airlines, 25 Broadway, New York 4, N.Y., M.

True Drift, Army Air Forces, Selman Field, La., W.

Tulsa Douglas Airview News, Douglas Aircraft Co., Inc., Tulsa, Okla., W.

The Twin Prop, Pilot School (Advanced Two Engine), Army Air Forces, Stockton Field Calif., W.

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U.S., Army Air Forces, Technical Publications for Army Air Forces Technical Libraries, Book List, Library Branch, Washington 25, D.C., Irreg.

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U.S., Civil Aeronautics Administration, Technical Development Notes, Washington 25, D.C., Irreg.

U.S., Civil Aeronautics Administration, Technical Development Reports, Washington 25, D.C., Irreg.

U.S., N.A.C.A., Technical Memorandums, National Advisory Committee for Aeronautics, Washington 25, D.C., Irreg.

U. S. Air Services, Transportation Bldg., Washington 6, D.C., M, $0.25, $3.00.

United States Government Publications, Monthly Catalog, U.S. Govt. Printing Office, Washington 25, D.C., M, $0.20, $2.00.

United States Naval Institute, Proceedings, Annapolis, Md., M, $0.50, $4.00.

U. S. Steel News, United States Steel Corp. of Delaware, 436 7th Ave., Pittsburgh, Pa., Q.

Upcheck, Lewis School of Aeronautics, Lockport, Ill., M., $3.00.

The Valve, Wilcox-Rich Div., Eaton Mfg. Co., Battle Creek, Mich., M.

V.D.I. Zeitschrift, Edwards Bros., Inc., 300 John St., Ann Arbor, Mich., W, $19.00 yr.

The Volunteer, Consolidated Vultee Aircraft Corp., Nashville Div., Nashville, Tenn., W.

Vox Prop, Air Service Command, Army Air Field, Rome, N.Y., W.

The Waco Word, Waco Aircraft Co., Troy, Ohio, M.

War Medicine, 535 N. Dearborn St., Chicago 10, Ill., M, $0.75, $6.00.

War Production Drive, Summerill Tubing Co., Bridgeport, Montgomery County, Pa., M.

Warplane Production, Aircraft War Production Council, Inc., 7046 Hollywood Blvd., Los Angeles 28, Calif., BM.

The Wasp Nest, Pratt & Whitney Aircraft Corp. of Missouri, Kansas City, Mo., M.

Weight Engineering, Society of Aeronautical Weight Engineers, Inc., 143 N. Brand Blvd., Glendale 3, Calif., Q, $0.50, $1.75.

The Welding Journal, 33 W. 39th St., New York 18, N.Y., M, $0.75, $5.00.

West Coast Air Mail Society, Bulletin, Ralph A. Freiburg, 4142 26th St., San Francisco 14, Calif., BM.

Western Flying, 304 S. Broadway, Los Angeles 13, Calif., M, $0.25, $2.00.

Wheelco Comments, Wheelco Instruments Co., Harrison & Peoria Sts., Chicago 7, Ill., BM.

Williams Field Airfax, Army Air Forces, Williams Field, Chandler, Ariz., W.

Wing Tips, Mid-Continent Airlines, Inc., Waltower Bldg., Kansas City, Mo., M.

Wing Tips, Pilot School (Specialized Two Engine), Mather Field, Sacramento, Calif., W.

The Wingfoot Clan, Aircraft Edition, Goodyear Aircraft Corp., 1210 Massilon Rd., Akron 15, Ohio, W.

The Wingfoot Clan, Arizona Edition, Goodyear Aircraft Corp., Litchfield Park, Ariz., W.

Wings, McGraw-Hill Publishing Co., Inc., 330 W. 42d St., New York 18, N.Y., M.

Wings, 1 Marion St., Wellington, N.Z., M, 6*d*., 10*s*.

Wings Club, Inc., Bulletin, 50 Vanderbilt Ave., New York 17, N.Y., M.

Wingspread, Army Air Forces, Peterson Field, Colorado Springs, Colo., W.

Wing-Tips, Waco Army Flying School, Waco, Tex., W.

Wright at the Moment, Wright Aeronautical Corp., Paterson, N.J., W.

Yuma Actioneer, Army Air Field, Yuma, Ariz., W.

Zoom, Basic Flying School, Army Air Forces, Bainbridge, Ga., W.

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Government Publications

Army Air Forces

Findings Obtained in Flight Measurement with the "Raethjen" Ciné-Theodolite Apparatus of the German Research Institute for Soaring Flight is a translation of an article by A. Schieferdecker and W. Gebhardt, appearing in *Jahrbuch 1938 der Deutschen Luftfahrtforschung*. This paper is divided into two parts, the first constituting a report on flight measurements made with the Raethjen ciné-theodolite apparatus at the German Research Institute for Soaring Flight. These measurements were used to gather findings on the usefulness of this apparatus for aerodynamic research, especially of nonsteady processes, and to obtain an exact picture of the course of a nonsteady flight process (looping).

Coordinating the rate of climb at wide-open throttle with the downward vertical velocity in gliding without propeller, at the same speed of flight, led to a propeller-efficiency ratio that practically coincided with the efficiency ratio obtained for a free propeller in a wind tunnel. The angles of incidence of almost all the polars appear during the course of the loop, while the angular velocity of the airplane around its transverse axis and the time change of the flight-path angle show the expected similarity.

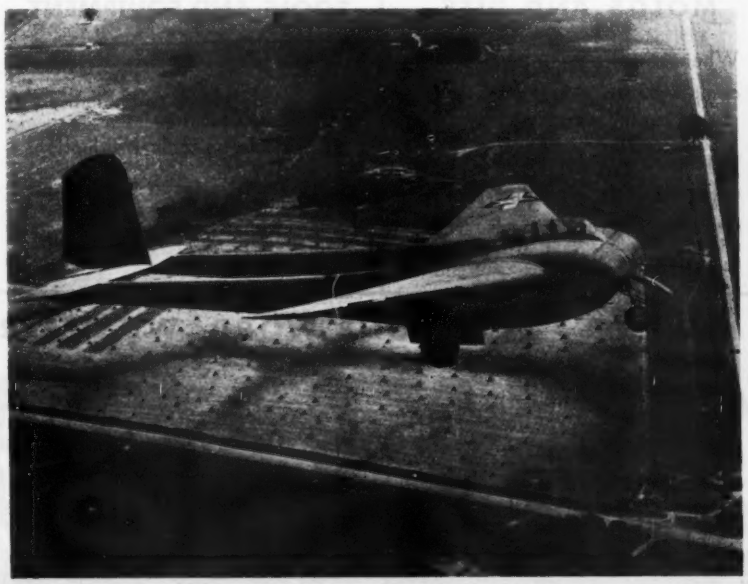
The acceleration of the airplane's center of gravity perpendicular to the flight path reaches a maximum of 3.3*g*, while the mass acceleration in the direction of the airplane's vertical axis amounts to 4.1*g* when both curves follow an otherwise similar course. The additional change in the angle of incidence of the elevator unit, as a result of the rotation of the airplane on its transverse axis, led to an additional angle of incidence of 10.2° at the upper vertex of the flight path, so that the airfoil chord of the control surface and the direction of flow were parallel for a maximum angle of deflection of 25° of the control surface, disregarding the downwash.

In Part II a comparison is made of a part of the study from Part I of a flight path with wind correction, by means of a Lanchester phygoid whose constants were determined beforehand from data of the flown loop. By plotting the flown values, deviations are revealed from the expected course, probably caused by the different propeller effects. In transforming the system of coordinates based on the measured values to a system based on the theory, a way was found to obtain better approximations to the empiric curves. The conformity was much better than had seemed possible when considering the limited assumptions offered by the phygoid theory. *Translation No. 380, Air Technical Service Command.*

More Power to You. Douglas J. Ingells. A review of the development of aircraft engines for fighters and bombers in which design improvements that have resulted in increased power output are described. Starting with the Liberty engine of the first World War, the writer outlines progressive developments that have brought aircraft engines to their present high state of efficiency. Reference is made to research and development work carried out by specialists of the Air Technical Service Command's Power Plant Laboratory, Pratt & Whitney Aircraft Division of United Aircraft Corporation, Wright Aeronautical Corporation, Allison Division of General Motors Corporation, and Packard Motor Car Company. Comparisons are made between the power output of modern aircraft engines and those of the past, and information is given showing how improvements in efficiency have been accomplished. *Air Force*, November, 1944.

The Center of Gravity of the Human Body as Related to the Equipment of the German Infantry, by W. Braune and O. Fischer, is a translation from *Akademie der Wissenschaften, Leipzig, Mathematisch-Physische Klasse, Abhandlungen*, Vol. 26, No. 7, 1889, and is one of a series of treatises. It includes an exhaustive study of the effects of center of gravity on the human body, with particular reference to the infantry soldier and all of the items of his equipment. Determination is made of the center of gravity of each of the various parts of the body under a wide variety of conditions and positions. *Translation No. 379, Air Technical Service Command.*

Interception Begins on the Ground. Charlotte Knight. This article tells how the Fighter-Control Stations o the A.A.F. operate. It is explained how fighters are directed by radio and radar to the proper position to meet the enemy at the right spot, the right altitude, the right time, and in sufficient numbers to destroy him. The directing of fighters from the ground is the duty of the Fighter Controller, who, unlike the man who directs traffic from an airport control tower, rarely sees the aircraft he is directing. An outline is given of the complex operations connected with air-



The XCG-16 experimental cargo glider.

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craft warning and control. *Air Force*, November, 1944.

Standard Flight Instrument Panel. Col. Thomas J. DuBose. A brief description is given of the standard arrangement for grouping basic instruments on the instrument panel as adopted by the Army Air Forces. Major advantages of the standard panel are listed. *Air Force*, November, 1944.

Development of two new "sky-freighter" gliders, the XCG-10A and the XCG-16, has been announced.

The aerial cargo carriers, now undergoing extensive flight tests, were developed to meet combat-taught requirements for gliders capable of delivering heavier and bulkier battle equipment by air. Both motorless transports are approximately 50 per cent larger than the CG-4A, the largest A.A.F. glider now in combat. The XCG-10A will carry 6 tons of aerial freight, approximately four times the capacity of the CG-4A, while the XCG-16 hauls a pay load of 5 tons.

Departure from normal cargo-glider design is evident in both gliders. Both types are of laminated-plywood construction and utilize tricycle landing gear with retractable nose wheels.

The XCG-10A is a high-wing monoplane with a broad, deep fuselage curving back from a rounded nose. The wing span is 105 ft., and the length is 67 ft. A comparatively small single tail boom extends from the top of the fuselage to a conventional tail assembly, which is set high to facilitate loading from the rear.

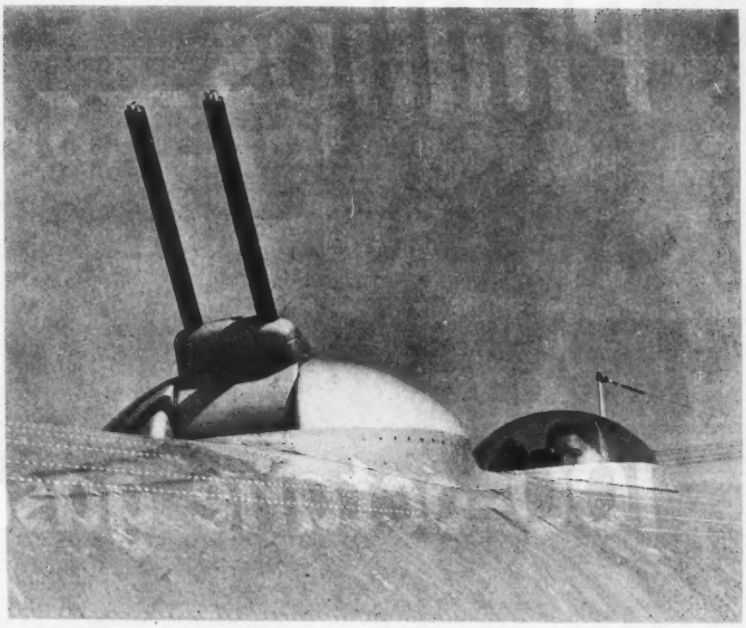
Clamshell-type doors under the tail boom swing out to provide access to the cargo compartment from the rear of the fuselage. The cargo interior—almost 30 ft. long, 7 ft. high, and $8^1/_2$ ft. wide—is reported to be the only glider cargo space large enough to contain such bulky equipment as a fully assembled 135-mm. howitzer or a $2^1/_2$-ton truck.

After construction of the XCG-10A by the Laister-Kauffmann Aircraft Corporation of St. Louis, Mo., the aircraft was subjected to exhaustive structural tests in Wright Field laboratories before shipment to the Clinton County Army Air Field for flight tests. A four-engined tow plane such as the B-17 or C-54 is required when the "air freighter" is fully loaded, although only a normal pickup and landing area is necessary.

The XCG-16, a high-wing monoplane glider, represents a trend toward the flying-wing design. Not a true flying wing because a tail is utilized, the glider nevertheless uses an airfoil section as a fuselage. The extremely wide but shallow fuselage is apparently a wider center section of the wings. Twin tail booms, described as being used for the first time in American glider construction, extend from the rear of the fuselage to the tail surface and single vertical fin. The wing span is 91 ft. 9 in., and the length is 48 ft. 3 in.

The leading edge of the fuselage section is in reality a set of twin Plexiglas doors, lifting upward by means of hand-operated jacks. The forward section of the cargo floor is hinged and lowers forward for use as a loading ramp. Twin cargo compartments, separated by a structural riblike wall, will carry a jeep type of vehicle in each section or one 75-mm. howitzer. Each cargo section is 15 ft. long, almost 7 ft. wide, and tapers from a maximum height of 5 to $2^1/_2$ ft. Unlike the XCG-10A, in which pilot and copilot sit side by side, the cockpit of the XCG-16 is set on top of the winglike fuselage and is arranged in tandem.

The XCG-16 was originally brought to the attention of the A.A.F. by Hawley Bowlus. After modifications in design and specifications by A.T.S.C. engineers, the XCG-16 was constructed by General Airborne Transport, Inc., of Los Angeles. Upon completion, the craft was subjected to structural tests at Wright Field similar to those met by the XCG-10A. It was first flown from the Army's Oxnard, Calif., Flight Strip. It was then ferried cross-country to the Clinton County Army Air Field, where extensive flight tests are still being conducted. *Air Technical Service Command.*



One of the turrets of the Boeing B-29 Superfortress, with remote sighting station behind it. Because of the advanced fire-control system of the B-29, the gunner in this sighting station can fire not only the twin 0.50-cal. guns in the turret shown in this photograph but can, if the need arises, fire the guns of another simultaneously. In case he uses two turrets, all guns are aimed at the same target, increasing the bomber's fire power.

At Wright Field's recently completed vertical wind tunnel aerodynamic tests are now being conducted on future A.A.F. planes still in the blueprint stage. The new structure is used for tests for airplane spin characteristics, terminal-velocity studies, parachute research, and experiments with helicopter rotor blades. The tunnel is stated to be the largest and fastest free-flow, open-throat, vertical wind tunnel in the world.

A 12-ft. cylinder that runs up the center of the building serves as the test chamber and operational center of the tunnel. An upward air stream is drawn through the test section and returned down an annular air passage between the inner cylinder and the outside concrete walls of the building by a four-bladed wooden propeller 16 ft. in diameter. The propeller is turned by a 1,100-hp. electric motor mounted above the propeller at the top of the tunnel. Variations in air stream, ranging from almost zero to more than 100 m.p.h., are accomplished by means of a controllable-pitch arrangement on the propeller rather than by changes in the motor speed. The walls of the test section are faced with polished maple flooring to minimize airflow turbulence.

Tests are conducted from a recessed observation balcony, which opens into the tunnel throat, halfway up the test section. Model planes, built to scale from designer's specifications for new aircraft, are placed in the airflow, which sweeps upward at a predetermined speed sufficient to sustain the miniature. As the model spins, dives, or climbs in the air stream, synchronized motion-picture cameras located at the top and side of the test section record every motion and reaction of the plane. Subsequent study of these film records enables A.T.S.C. engineers to anticipate performance of a new craft and to detect design errors.

Wing spreads of the models range from 2 to 3 ft., or approximately one-thirtieth that of a full-scale plane. The miniatures are accurate to within $^1/_{100}$ in. and are balanced by weights to within $^1/_{10}$ Gm. Each free-flying model contains a complete set of con-

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trols, including ailerons, flaps, rudder, and elevators, which are operated by remote control. The remote-control mechanism consists of twelve 1/2-in. solid copper cables banded together to circle the inner wall of the test chamber, which activates the controls in the model plane magnetically. As the power flowing along the copper rings is turned on or off, the position of the magnetized controls is changed and the flight pattern of the model is varied at the will of the operator on the observation balcony. When the test is completed the propeller is stopped, the airflow ceases, and the model falls into a net stretched across the base of the test section.

As the A.T.S.C. continues its experimental development of the helicopter, the vertical tunnel is expected to be the scene of much important research on rotor blades. Mounted on a streamlined hub at the base of the tunnel, model rotor blades can be tested for vibration and stress analysis while subjected to simulated flight conditions created by the up-sweeping airflow. Parachute models will be tested for "sway" in the air stream and, when attached from beneath to a force-recording mechanism, will be checked to determine the weight the parachute can safely support in descent. *Air Technical Service Command.*

Metals Reserve Redistribution Program has been in operation since the middle of August. The plan was developed to effect the most complete utilization of property resulting from contract terminations. It is concerned only with supplies of steel, aluminum, copper, and certain other items of hardware and components. The plan was initiated by the Army Air Forces, the Bureau of Aeronautics of the Navy, and the Metals Reserve Company, a subsidiary of the Reconstruction Finance Corporation.

Under the plan, surplus stocks owned by the Government which are released by one contractor and which are in excess of certain established minimums are reported to the Aircraft Scheduling Unit at Wright Field. These surpluses are first offered to the military aircraft supplies divisions for their maintenance requirements, and, subsequently, materials unclaimed by the services are reported to the Metals Research Company, which acts as a disposal agency under an agreement with established distributors of the listed commodities.

The functions of the organization are described, and statistics are given concerning the amounts of material that have been routed back into productive channels where they are needed. A flow chart shows how this distribution is accomplished. *Air Technical Service Command.*

Civil Aeronautics Administration

Approval of Extension Shaft Drives. A number of presently projected aircraft designs that have come to the attention of the Civil Aeronautics Administration incorporate extension drive shafts and propeller gear boxes which are separate from the engine. In some cases the extension drive parts are being designed by engine manufacturers who are generally aware of the requirements for approval of such equipment. However, in a number of cases aircraft manufacturers are evolving their own designs, and there is evidence of the fact that some of these manufacturers are not fully aware of the extent of investigation and testing necessary for type certification.

The factors governing the approval of drives of this type are discussed, and suggestions are made for testing the drive components. The discussion applies only to drives that transmit the power of two or more engines, and their effect on the classification of aircraft as single- or multiple-engined types are discussed in a separate release. *Safety Regulation Release No. 168,* November, 1944.

Statistics About Airports. Tables prepared recently by the Airport Service of the Civil Aeronautics Administration give figures concerning the number of airports in the United States equipped with hangars and without hangars. They also give the acreage of various airports classified according to size. Figures are included about the average acreage per airport in various population groups.

Department of Agriculture

Six additional reports have been published in the series issued in cooperation with the Army-Navy-Civil Committee on Aircraft Design Criteria under supervision of the Aeronautical Board, in cooperation with the University of Wisconsin. They are as follows:

Supplement to Design of Plywood Webs in Box Beams is No. 1318-C in the series. It contains a report of additional tests of box beams and plywood webs to substantiate further the design curves for plywood webs in box beams. The beams discussed in this report were designed to fail by shear in the webs. The stresses in the compression and tension flanges and in shear in the glue lines joining the flanges and webs were not critical at failure. The conclusions are summarized.

Analysis for Filler Content of Urea-Formaldehyde Glues is No. 1333 of a series and deals with methods of analyzing fillers desirable to use in an urea-formaldehyde adhesive. Six methods are outlined and the results are tabulated.

Air-Seasoning Aircraft Stock is No. 1366. It gives suggestions for methods to be followed in storing and seasoning surplus stocks of lumber for aircraft uses.

Strength of Glue Laminated Sitka Spruce Made Up of Rotary-Cut Veneers is No. 1512. The purpose of this investigation was to study the strength of solid wood or laminated stock for sawed and other wood airplane parts, as well as the effects of cross grain, scarf joints, and orientation of laminations. The tests included static and impact bending, compression parallel to grain, shear parallel to the grain, and toughness.

The general conclusion is that, on the basis of strength values, Sitka spruce laminated from rotary-cut veneer is satisfactory as an alternate to solid members or members laminated from sawed stock, provided the same requirements for straightness of grain, limitation of defects, and specific gravity of the wood (exclusive of glue) are observed.

Effect of Length on the Buckling Stresses of Thin-Walled, Plywood Cylinders in Axial Compression is No. 1514. This report gives the data and analysis of results of tests performed at the Forest Products Laboratory on short, thin-walled, plywood cylinders loaded in axial compression. The results of tests of long specimens, which have been presented in Forest Products Laboratory Mimeograph 1322-B, show that a cylinder having a length greater than its diameter exhibited buckling characteristics similar to those theoretically assumed to be correct for specimens of infinite length (Forest Products Laboratory Mimeographs 1322 and 1322-A). This report presents an empiric design curve for plywood cylinders of lengths shorter than the diameters. This curve is to be used in conjunction with the design curves of Forest Products Laboratory Mimeograph 1322. It is in reasonable agreement with published results of similar tests on metal cylinders.

Properties of Laminated Plastics Made from Lignin and Lignin-Phenolic Resin-Impregnated Papers is No. 1595. This report is concerned with the development of plastic laminates from paper impregnated with solutions of lignin or mixtures of lignin and phenolic resins. Since lignin is potentially both abundant and inexpensive, the extension of phenolic resins with lignin is attractive provided the quality of the resultant plastic is not seriously reduced. The work reported is limited and is to be considered only as a preliminary survey to determine approximately the effect of certain major variables on the properties of lignin resin and lignin-phenolic-resin paper-base laminates. *United States Department of Agriculture, Forest Service, Forest Products Laboratory.*

Department of Labor

Safety Speeds Production is the title of Special Bulletin No. 10 issued by the Department of Labor and reprinted for Army Air Forces personnel by special arrangements with the Division of Labor Standards. It is a pamphlet of 14 pages intended to promote safety in manufacturing plants. *Division of Labor Standards.*

Department of State

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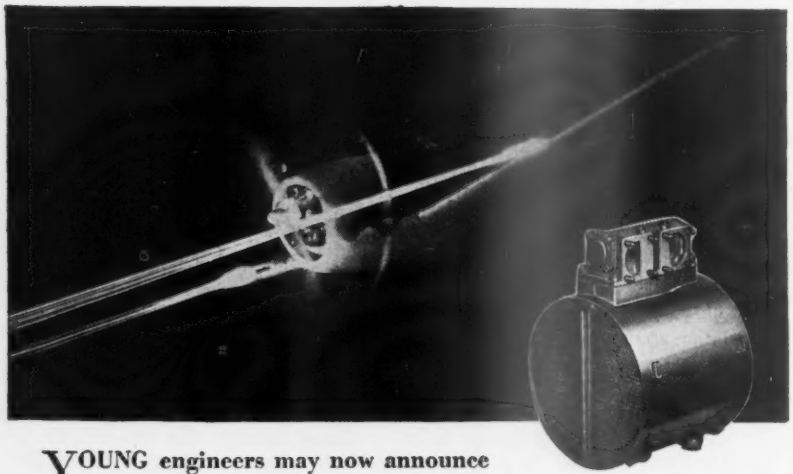

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dated October, 1919, with its annexes, has been reproduced from Official Bulletin No. 26, December, 1938, of the International Commission for Air Navigation. It is printed in English, French, and Italian, in parallel columns. In addition to the main sections of the document, there are eight annexes referring to classification of aircraft; certificates of air worthiness; log books; rules for lights, signals, and air traffic; operating crew; aeronautical maps and ground signs; meteorologic information; and customs. There are also added the protocol of proposed amendments to certain articles of the conventions and a protocol of proposed amendments to the annex regarding customs.

National Advisory Committee for Aeronautics

The Wall Interference of a Wind Tunnel of Elliptic Cross Section. Itiro Tani and Matao Sanuki. Translated from the *Journal of the Society of Mechanical Engineers*, Japan, February, 1933. The wall interference is obtained for a wind tunnel of elliptic section for the two cases of closed and open working sections. The approximate and exact methods used gave results in practically good agreement. Corresponding to the result given by Glauert for the case of the closed rectangular section, the interference is found to be a minimum for a ratio of minor to major axis of $1:\sqrt{2}$. This, however, is true only for the case where the span of the airfoil is small in comparison with the width of the tunnel. For a longer airfoil the favorable ellipse is flatter. In the case of the open working section the circular shape gives the minimum interference.

The problem of the interference exerted by the tunnel walls is treated with the aid of the known results of the vortex-filament theory applied to the boundary. In the present paper the wall interference is treated as a Dirichlet problem. Depending on whether the boundary conditions are completely satisfied or satisfied at only a determined number of points, an exact or approximate solution, respectively, is obtained. The reason both are given is to show that for practical purposes the difference in the results obtained is negligible and to emphasize the usefulness of the latter method when the former is not available. *Technical Memorandum No. 1075*, November, 1944.

New York State Education Department

Fundamentals of Pressure and Temperature Instruments is one of a series of monographs prepared in the National Defense Curriculum Laboratory at Cornell University, with the cooperation of the Taylor Instrument Companies, as a part of the New York State War Production Training Program. It is a ring-bound volume of numbered information sheets containing

descriptions of the construction, operation, and uses of numerous instruments for measuring temperature and pressure. It also contains a group of sheets called laboratory units, describing and illustrating laboratory equipment used for studying and measuring the properties of fluids. Lists of equipment and materials required for the laboratory work, tables of equivalents, and an index of the information sheets are included in an appendix. *Bureau of Industrial and Technical Education.*

War Department

Index of United States Army and Federal Specifications Used by the War Department lists specifications of the United States Army and Federal Specifications that cover items and materials commonly purchased by agencies of the War Department. Federal Specifications are promulgated in a standard form for use by the several departments and independent establishments as purchasing instruments and contain the technical requirements necessary to describe the item or material. The Federal Specifications are listed alphabetically, and a separate list places U.S. Army Specifications in numerical order. For sale by Superintendent of Documents, Washington, D.C., $1.50 including twelve monthly supplements.

British Information Services

The Stressing of Gyroplane Blades in Steady Flight. J. B. B. Owen. Some refinements have recently been introduced into gyroplane aerodynamics, but the conventional procedure for stressing blades has remained in a rather unsatisfactory semiempiric form. It appeared desirable, therefore, to devise a more rigorous method of stressing the blades which incorporates these recent aerodynamic improvements.

No new aerodynamic work is undertaken in this first report, and consideration is restricted to the stressing of blades in steady flight. The loading actions on a blade are analyzed into two components: a transverse load system that tends to bend the blade and an extensional system that tends to reduce this bending. The equation of elastic equilibrium of a blade under the action of these loads is then formulated. The difficulty of solving this equation has occasioned the use, in practice, of empiric rules, which reduce considerably the "nominal" bending moment as estimated from the transverse loading acting alone. In the present report "type solutions" are constructed which satisfy this equation and the appropriate end conditions. Such solutions are then combined to give approximately the estimated transverse loading. Since the bending moments, deflections, etc., associated with each "type solution" are known, that corresponding to the given loading is obtained by the addition of the "type solution" contributions.

The "type solutions" method of attack provides a rapid means of estimating the blade stresses and is effective in demonstrating the influence of design parameters. In particular, it is shown that increased flexural stiffness of the order of current practice (all other quantities remaining unchanged) results in slightly decreased blade-bending stresses. For the "C.30A Autogiro" in steady flight both the direct tensile and bending stresses in the blades are small but of the same order. *Ministry of Aircraft Production, Aeronautical Research Committee Reports and Memoranda, R. & M. No. 1875*, British Information Services, New York, $1.65.

Steady Two-Dimensional Flow Past a Solid Cylinder in a Non-Uniform Stream and Two-Dimensional Wind-Tunnel Interference. S. Goldstein. Two papers are included in this one Technical Memorandum. In the first paper the theoretic investigation was originally undertaken to estimate the effects on two-dimensional tests of airfoil sections in a wind tunnel produced by departures of the tunnel stream from straight uniform flow. In the compressed-air tunnel at the National Physical Laboratory, for example, the static pressure first falls and then, after reaching a minimum, rises again as the distance downstream from the nozzle of the jet increases, so the stream velocity rises to a maximum and then falls.

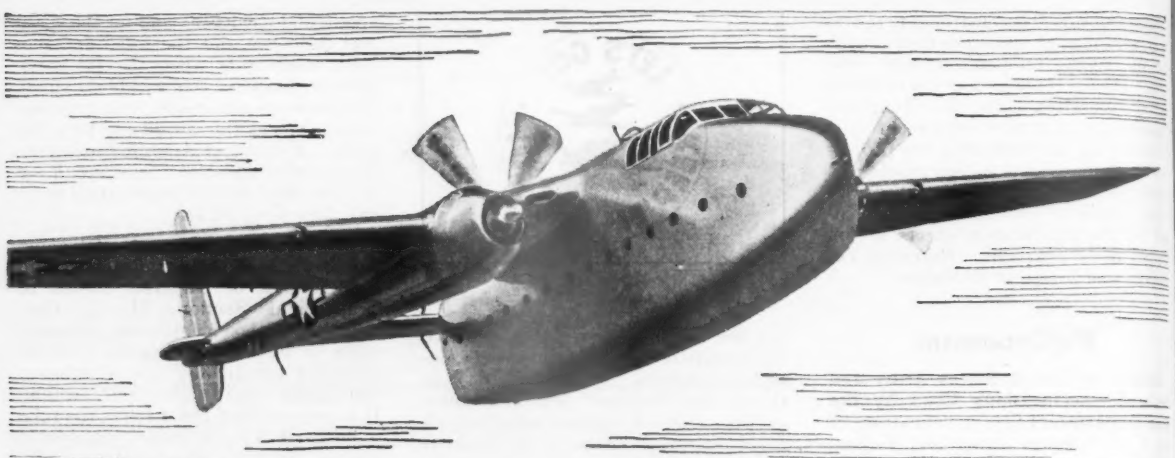
The calculations refer to irrotational motion only, and the flow around the test section is treated as two-dimensional. General formulas are obtained for flow past any cylinder whose section can be conformally transformed into a circle; the cylinder is placed in a stream in which the undisturbed velocity may vary with position and the undisturbed streamlines may be curved. The formulas show the effects of the departures from straight uniform flow on the forces and moment experienced by the cylinder and on the pressure distribution around it, as well as the change in the circulation on the Kutta-Joukowski hypothesis. The application of these theoretic results is discussed.

The results obtained are applied to the theoretic calculations in the second paper, which is divided into two parts. The first part describes the investigations made and gives general results. The second part is concerned with tests of an airfoil in the middle of the tunnel, the influence of the profile drag on the constraint of the tunnel wall being neglected. Formulas are given for the forces and the moment in terms of the circulation; for the circulation itself; for the force and moment coefficients, speed, and incidence; and for the speed and incidence and the force and moment coefficients when the thickness, camber, and force coefficients are small. Comparisons are made with previous results for any thin airfoil and for a flat plate. *Ministry of Aircraft Production, Aeronautical Research Committee R. & M. No. 1902*, British Information Services, New York, $2.75.

On the Stressing of Polygonal Tubes with Particular Reference to the Torsion of Tapered Tubes of Trapezoidal Section. H. L. Cox. A general method for stressing polygonal tubes is described and applied to the torsion of parallel and tapered tubes of rectangular and trapezoidal section. It is assumed that the shape of the tube is maintained by a limited number of frames. In treating parallel tubes deformation of these frames in their own planes is taken into account; the effect of this deformation is shown to be small, and, in treating tapered tubes, the frames are assumed to be rigid in their own planes. The method of stressing tapered tubes in torsion is applicable to any tube of trapezoidal section with one plane of symmetry, no matter how the dimensions may vary along the length of the tube; in particular, the method is directly applicable to tubes having portions of their walls cut away. The successive stages in the computation are set out in tabular form and illustrated by worked examples, including cases with "cutouts."

The final stage in the computation involves the solution of a set of simultaneous equations equal in number to the number of frames, but these equations are of a special type, readily solvable by a straightforward process without danger of any serious loss of accuracy. The length of the computation is directly proportional to the number of frames, but it is demonstrated by examples that the stress distribution is affected only slightly by the addition of extra frames, so that in practice it should normally be permissible to ignore all but a few of the frames. In the special case of a conically tapered tube in which the wall thicknesses are uniform along the length of the tube, the results can be generalized to include the case of a tube with an infinite number of rigid frames. In this case the results obtained by the present method become identical with those obtained by Williams in *R. & M. 1761* and by others using Williams' method. *Ministry of Aircraft Production, Aeronautical Research Committee R. & M. No. 1908*, British Information Services, New York, $2.75.

The Calculation of Aerodynamic Loading on Surfaces of Any Shape. V. M. Falkner. The object of the report is to establish a routine method for the calculation of aerodynamic loads on wings of arbitrary shape. The method developed is based on potential theory and uses a general mathematical formula for continuous loading on a wing which is equivalent to a double Fourier series with unknown coefficients. In order to evaluate the unknown co-



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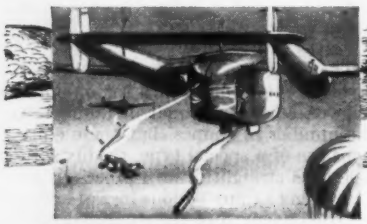

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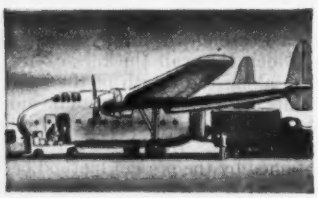

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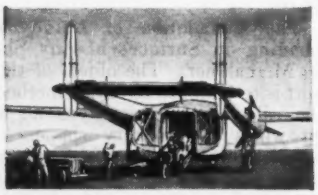

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efficients, the continuous loading is split up into a regular pattern of horseshoe vortexes, the strengths of which are proportional to the unknown coefficients and to standard factors that are given in a table. The total down-wash at chosen pivotal points is obtained by summing the down-washes attributable to the individual vortexes, a process which is simplified by the use of specially prepared tables of the properties of the horseshoe vortex. By equating the down-wash to the slope of the wing at each pivotal point, simultaneous equations are obtained, the solution of which defines the unknown coefficients.

The first layout involves a total of 76 vortexes over the wing, and a second layout, involving a total of 84, is shown to be of superior accuracy. The effect on the solution of the number of pivotal points is investigated, and it is concluded that by making a suitable choice it is unnecessary to use a large number. Results for a rectangular wing at 0° and an elliptic wing at 0° and 30° yaw are compared with those obtained by other workers. It appears that there may be errors in published results in a least one of these cases. Immediate development includes the application to the calculation of the characteristics of actual sweptback wings, including rotary derivatives, and future development includes also applications in wind-tunnel design and technique. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1910,* British Information Services, New York, $1.05.

Wind Tunnel Interference Effect on the Values of Experimentally Determined Derivative Coefficients for Oscillating Aerofoils. W. Prichard Jones. A theory is developed for estimating tunnel-interference effects on measurements of aerodynamic derivatives for a rectangular wing describing pitching and translational oscillations in a closed wind tunnel of rectangular working section. The formulas deduced are applied to the particular case of a wind tunnel with a square working section and wings having a span equal to two-thirds of the tunnel width. It is shown that the interference effects on all the derivatives are negligible when the frequency parameter is greater than unity. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1912,* British Information Services, New York, $1.05.

Abstract of the Factories (Testing of Aircraft Engines, Carburetors, and Other Accessories) Order, 1944, contains a brief résumé of various provisions of the British Factories Order, intended to be posted in each control room and engine room in a position where it can easily be read by all persons employed in the room. The various paragraphs refer to the provision of the laws enacted to promote safety in those sections of factories where the testing of aircraft engines, carburetors, and other accessories is carried out. Each paragraph is numbered to correspond to the section of the law bearing on the particular subject of the paragraph. *British Information Services,* New York, $0.05.

British Ministry of Labour and National Service and the Ministry of Production

Controlling the Plan in the Shop. The fourth and final article in a series describing the methods used for controlling production in a British aircraft plant employing about 2,000 workers refers particularly to control methods in the shop. The earlier articles were devoted to a description of the systems adopted for the planning of production and for the control of the work preparatory to manufacture.

In the current article details are given about a plan for hour-by-hour control through use of what is called a loading board. The construction of this board is described and its uses are explained. In addition to the detailed explanation of the operation of the loading board, the reasons for using it are detailed. The problems involved in the installation are discussed and the advantages obtained by the method are given. *Production and Engineering Bulletin,* October, 1944.

South African Government Information Office

South Africa on Service is an illustrated booklet, originally printed in the Union of South Africa and reprinted in the United States. It gives a pictorial record of the work of the Union of South Africa on the home front from 1939 to 1943. A foreword is written by Field Marshal J. C. Smuts, Prime Minister, and a message is included from H. J. van der Bijl, Director General of Supplies. Its different sections describe the facilities of the Union for the manufacture of steel, guns, shells, bombs, small-arms ammunition, and other military supplies. Extensive information is given about the sources of raw materials and the employment of the resources of the Union as a contribution to the war effort of the United Nations. *South African Government Information Office,* Washington, D.C.

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(*Continued from page 25*)

installation includes a laminated rear pane with thick vinyl plastic interlayer and glass faces, with extended plastic edges bolted into the windshield frame.

(2) Full-tempered glass or laminated semitempered glass with approximately 0.060-in. vinyl plastic interlayer and bolted extended plastic edges may be used for the front deicing pane of the double-pane arrangement.

(3) Impact resistance sufficient to withstand the collision of a 14-lb. carcass at a velocity of 200 m.p.h. may be obtained with $^3/_8$-in. thickness of the vinyl plastic interlayer in the rear pane of a double-pane installation of the size and mounting angle of the full Douglas DC-3 windshield.

(4) An optimum plasticizer content of the vinyl plastic interlayer exists for each given temperature condition of the windshield panel. A 20 per cent plasticizer content represents about an optimum value for a normal warm-air deicing-type windshield.

(5) A plastic sheet of methyl methacrylate or similar type elastically mounted behind or bonded to the rear glass face of the windshield will minimize the danger of flying glass splinters.

(6) The rear pane of a double-pane windshield installation should be bolted, riveted, or otherwise uniformly and securely attached to the windshield frame around the entire edge of the panel to obtain maximum impact strength. Concentration of the principal stiffness of the frame at the ends of the panel is advantageous.

(7) The angle of impact strongly affects the impact resistance of the windshield panel. However, further data are required in this connection.

(8) The type of windshield panel found to provide the maximum impact strength has been indicated to be optically satisfactory.

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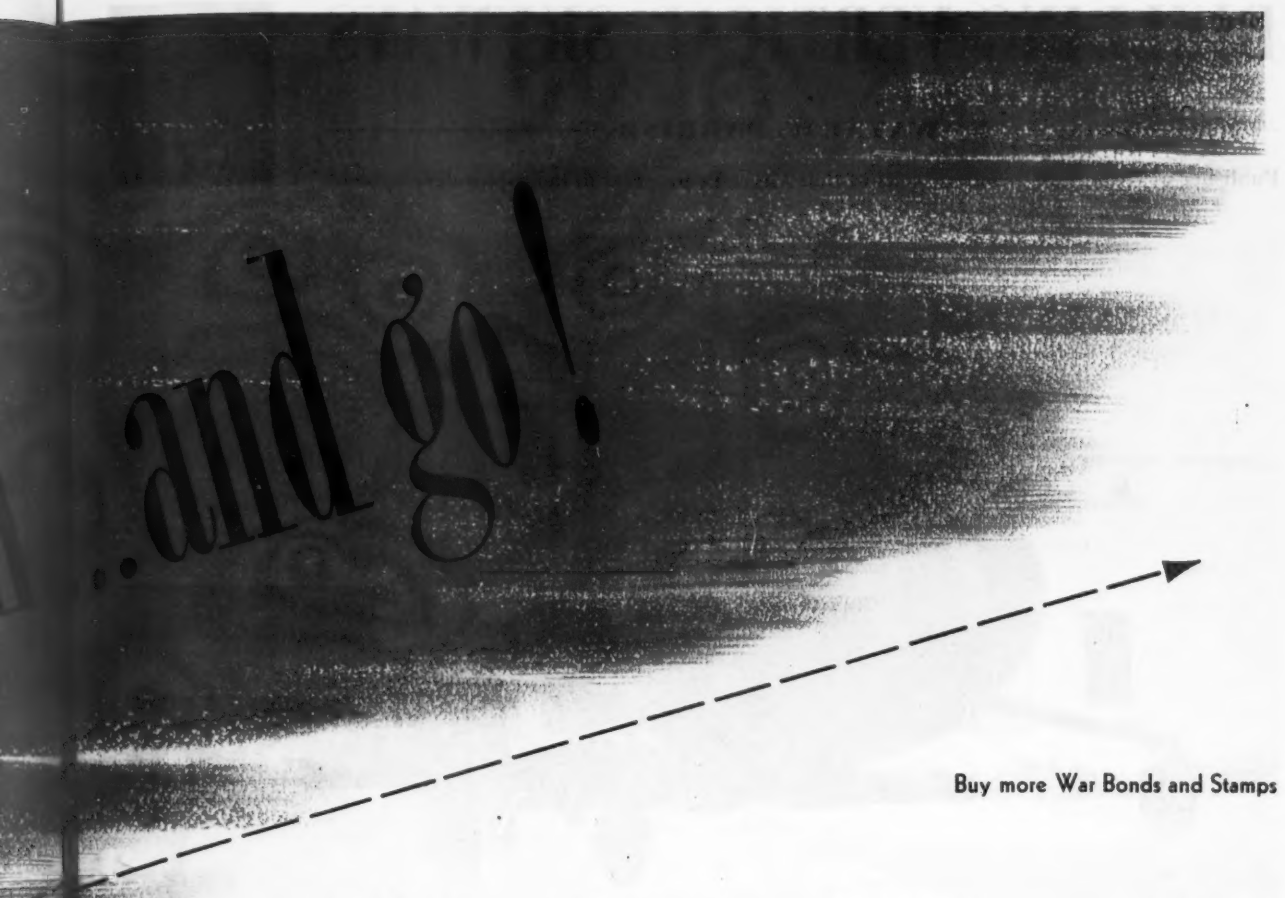

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By WAYNE W. PARRISH

Publisher of "American Aviation" tells of Bell Aircraft's progress in helicopter development

"IN my estimation it will be some time before flying around the country in a helicopter becomes widespread. However, great strides are being made in the development of rotary wing aircraft. One outstanding achievement is Bell Aircraft's new helicopter which, largely through *two* ingenious innovations, has made possible both stability and precision control.

"One innovation is a two-bladed rotor, supported on a universal joint so that it is free to 'see saw' and at the same time to turn on its longitudinal axis. The second is a bar which, gyroscopically, tends to keep the rotor in its plane of rotation regardless of the position of the mast. This is a basic Bell Aircraft patent which works for stability under all conditions. It is found only in the Bell helicopter.

"The Bell helicopter represents a type of aircraft men have long wanted. It can take off and land on a very small plot of ground, and even in winds of nearly gale force it can fly up, down, backwards, forwards and sidewise—and still remain stable and under perfect control.

"When ceiling and visibility are too poor for a fixed wing plane to fly—then it's 'helicopter weather'—for the helicopter can slowly, safely feel its way through murk or fog.

"The helicopter will have many important industrial uses in the postwar world. Plans are already being formulated for its use in crop dusting, forest fire patrol, pipe line patrol, emergency rescue work, feeder taxis for airlines, executive travel, and many other peacetime applications.

"When this progressive company can turn its skills and resources to producing peace-time needs, look to the Bell helicopter to be one of the leaders in the postwar aviation field."

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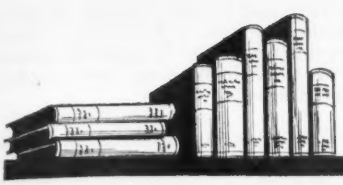

BOOKS

The Coming Air Age

Reginald M. Cleveland and Leslie E. Neville

Contents: When Peace Comes; Air-Age Geography; Freedom of the Air; The Airline of the Future; Freight by Air—The Economics of Air-Cargo Carrying; The Airplane of Tomorrow—Commercial Flying Equipment; Aircraft and Economics of Private Flying; The Airport of the Future; Air-Traffic Control; Air-Age Education; The Global Aerial Police Force; Epilogue.

This book was written by two men who are accurate and informed specialists on aviation in all its phases. They have produced a book that looks into the future and gives their ideas as to the role aviation will play in the postwar world.

From the geographic, social, and economic standpoints they give confident predictions regarding the coming surge of air transport to high levels and the resulting effects on world economy. There is scarcely a problem that will confront the air-transport industry, the statesmen, or the peacemakers that is not explored with intelligent comment. The study includes the political aspects of world aviation, air transport, future commercial and private aircraft, airports and air traffic, air training, regulation, and air power.

The book will be valued for its sound and authoritative treatment of these all-important questions. Whittlesey House, McGraw-Hill Book Company, Inc., New York, 1944; 359 pages, $2.75.

Civil Aviation and Peace

J. Parker Van Zandt

Contents: The Basic Conflict Over Civil Aviation; What is Civil Aviation?; Civil Aviation and Air Power; Past Attempts at Control of Aviation; Current Control Proposals; Air Transport and International Economic Stability; Possibilities in Mass Air Travel; A Program of Maximum Use.

This is the second study Dr. Van Zandt has made for The Brookings Institution, the first having dealt with the geography of world air transport. The current book is timely, since it deals with many of the questions that have been under discussion at the International Civil Aviation conference in Chicago.

The thesis of this volume is that aviation possesses immense possibilities for good or evil and represents both a threat and a promise. It can destroy in war but it can be equally constructive in peace. The author, by presenting the problems to be met in postwar air transport, gives a program that he hopes will assure economic stability, prosperity, and consequent peace in the world.

Each chapter is well documented and many of them contain statistical tables necessary for a broad understanding of both air transport and its regulation. The economic effects that may result from mass air travel are studied in detail. The concluding chapter reviews the progress made by civil aviation and proposes an expansion of civil air transport on a "maximum use" basis as a contribution to peace. An appendix contains a report on the efforts that have been made to achieve air disarmament. A second appendix contains statistics on civil aviation, and a third brings together statistical data bearing on various aspects of international air travel.

The book is indispensable for anyone who wants to become informed regarding the many problems ahead in the field of international air transport. The Brookings Institution, Washington, D.C., 1944; 157 pages, $1.00.

With the exception of aeronautical annuals and books published outside the United States, books reviewed in this section may be borrowed without charge from The Paul Kollsman Library of the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

The Air Forces Reader

Edited by Norman Carlisle

Contents: Wings for Victory; Prelude to Combat; Battle in the Skies; Of Men and Planes.

No other book that has appeared gives such broad coverage of the work of the Army and Navy Air Forces. The editor and his associates have selected from current articles some of the outstanding statements and descriptions written about the war.

Beginning with General Arnold's report to the Secretary of War, Vice-Admiral McCain's "The Blitzkreig Goes to Sea," and Lieutenant Colonel Silsbee's history of the Army Air Forces, articles follow on training, navigation, and meteorology. The chapter "Battle in the Skies" gives a comprehensive view of air warfare by reprinting twelve stories about aerial combat and bombing missions. "Of Men and Planes" includes 37 miscellaneous descriptions of actions by individual airmen, crews, and airplanes that have made air history.

It is truly an anthology of military flight and is to be commended to the reader who wishes an overall picture of the accomplishments of our air forces in this war.

Supplements contain information about the relative ranks of officers of the Allied armed forces, technical data, statistics, and glossaries of military and naval aircraft terms. The Bobbs-Merrill Company, New York, 1944; 406 pages, $3.75.

Fighting Wings

Gilbert Paust and Milton Lancelot

Contents: World War I; World War II; Heavy Bombers; Medium Bombers; Torpedo and Dive Bombers; Fighters; Transport Aircraft; Reconnaissance and Patrol Planes; Assault on Fortress Europe.

This is one of the best general histories of military aviation that has been written. The illustrations are all action pictures and trace the development of reconnaissance, pursuit, and bombing planes from their inception.

Unfortunately, the pictures are not related to the text on each page and this makes it difficult to read continuously. One of the authors, Milton Lancelot, takes credit for the design of the book. He would have made the text easier reading if he had broken up the long chapters with sub-headings. However, even with these handicaps the book contains valuable and interesting descriptions of the development of aviation in warfare. Essential Books, distributed by Duell, Sloane and Pearce, New York, 1944; 256 pages, $2.75.

Pilots All

Henry Felsen

Contents: "Get That Photographer!"; Knights of the Thin Air; Fighting Sky Teams; Tomcats of the Night; The Raiders Know Their Business; Grasshoppers of the Battlefronts; Monarchs of the War Skies; Dive-Bombing

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Many books have been written about one type of pilot. This book describes the duties and exploits of 25 different kinds of pilots, each with a job so specialized that it requires intensive training. The scope of the book includes not only military operations but those of peacetime as well.

The book will give any reader a new impression of the art of flying. It demonstrates the need for men of all types for the many flying services the airplane can render. By relating experiences of individual pilots, the author has given the text a human-interest appeal that makes it doubly interesting. Harper & Brothers, New York, 1944; 204 pages, $2.50.

The Aviation Annual of 1945

Reginald M. Cleveland and Frederick P. Graham

Contents: The United States Army Air Forces; United States Naval Aviation; Aviation Training in the United States; Aviation Manufacturing Today in America; Postwar Employment and Reconversion Aviation Research; Aircraft of Tomorrow; Commercial Airlines; Private Flying and Airports; Epilogue; The Aviation Annual Directory; Aviation Books.

This annual is unique among year books. It is written by experts and specialists who bring the reader through 1944 in many aviation fields. The chapters are preceded by one or more forewords by outstanding leaders in the particular section of aeronautics to which the chapter is devoted.

The editors know who can best assemble the facts in each particular specialty, and they have been able to provide a most valuable compilation for those who wish to keep abreast of the fast-moving aviation industry.

The book is illustrated by excellent official U.S. Army Air Forces and Navy photographs, as well as pictures from industrial sources. It may be regarded as an authoritative review of aeronautical progress in the United States. Doubleday, Doran & Company, Inc., Garden City, N. Y., 1944; 205 pages, $3.75.

Clouds, Weather, and Flight

Thomas C. Gilmer and H. Erich Nietsch

Contents: Weather and the Atmosphere; Clouds; Temperature Variation and Its Effect; Atmospheric Circulation: Wind and Flight; Air Masses; Fronts and Frontal Clouds; Weather Maps and How to Read Them; Forecasting for Flight; Weather Hazards in Flight; Flight Without Power: Gliding and Soaring.

Written with the object of making practical weather forecasting easy, this book is not a formal text on meteorology but a summary of selected deductions from meteorologic science leading to a wider knowledge of weather conditions. The contents represent a development of the basic physical laws of the atmosphere into the principles of air-mass analysis and forecasting. In order to give the reader a scientific correlation for meteorologic changes and to further the knowledge of everyday weather-casting, a study of the clouds viewed from above as well as below is included. The resulting effect of the weather as applied to flying conditions, the creation of weather hazards, and the art of flight without power are discussed in detail. Diagrams and sketches portray pressure areas, fronts, cyclones, flight paths, and conditions governing gliding. Included in an appendix are weather maps, code tables, data on instruments, and other useful material. A glossary of meteorologic terms is also included. D. Van Nostrand Company, Inc., New York, 1944; 161 pages, $3.75.

Aerodynamics

Leslie R. Parkinson

Contents: Physical Properties of the Atmosphere; Effects of Deflecting Airstreams; Reynolds Number and the Bernoulli Theorem; Lift and Drag; Airfoils; Lift-Increasing Devices; Performance; Stability; Propellers; Wind Tunnels.

Both elementary and advanced phases of flight as encountered by the practical designer are briefly treated in this introduction to aerodynamics. The book has been written especially for members of design and testing departments and others not especially trained in aeronautics who need to be conversant with the terminology and modern theories of aerodynamics. The subject is covered with a minimum of mathematics, a high-school knowledge of algebra and trigonometry being all that is required to understand the equations used.

There is an introductory description of the atmosphere and its relation to aerodynamics. In the treatment of the theory of lift and drag simple explanations are given of how the calculations are derived and of the uses of a wind tunnel in measuring the forces on an airplane in various attitudes of flight. The subject of dynamic stability is reviewed. The application of high-lift devices is described in the discussion of wings and airfoil sections. Information is given about engineering flight tests. Tables and formulas are included for reference. The Macmillan Company, New York, 1944; 112 pages, $2.25.

Airport Engineering

H. Oakley Sharp, G. Reed Shaw, and John A. Dunlop

Contents: Size and Site of an Airport; Planning the Site Selected; Surveys Preliminary to Design; Grading; Drainage of Airports; Soil Stabilization; Flexible-Type Pavements; Rigid-Type Pavements; Airport Lighting; Airport Buildings; Construction and Maintenance Equipment.

Major problems that must be studied by the engineer engaged in airport construction are dealt with in this book. The fundamentals of grading and drainage are presented as they particularly apply to airport construction. Basic aspects of planning the site and the relation of the location of the site to the regional plan are considered. A chapter is devoted to the stabilization of airport construction with particular emphasis on its applications to the manipulation and treatment of soils for immediate and future heavy loads. Basic methods of design for subgrade support and surface pavements are described. John Wiley & Sons, Inc., New York, 1944; 150 pages, $5.00.

Book Notes

The Secant Time Sight, by P. V. H. Weems; Weems System of Navigation, Annapolis, Md., 1944; 36 pages, $1.50.

This book contains tables arranged primarily for Merchant Marine navigators who prefer to use the time-sight method of navigation. The author states that a further simplification results from the use of the Air Almanac in conjunction with the tables, in place of the present Nautical Almanac.

Plastics in Industry, by "Plastes"; Chapman & Hall, Ltd., London, 1944; 248 pages, 15*s*.

This is the second edition of a book about plastics and the plastics industry. An entire chapter is given to plastics in aircraft construction. In addition to the applications of plastics in industry, the various processes of molding and fabricating are described. New information has been added to several of the chapters, and a chapter on insulation has been inserted. A list of books and articles in periodicals about plastics is also supplied.

Aircraft and the Air, compiled and edited by Eric Sargent; Sampson Low, Marston & Company, Ltd., London, 1943; 767 pages, $1.89.

Fourth edition of an aviation directory and history. Accompanied by descriptions, illustrations are shown of representative airplanes and airships manufactured in Canada, Japan, and the United States, as well as in Great Britain, Germany, Italy, and other European countries. Separate sections of the book are devoted to descriptions and illustrations of gliders, parachutes, airplane instruments, navigation, instruments, aircraft engines of different types and various countries, engine instruments, airdromes, and seadromes. Listings are given of aircraft manufacturers, engine companies, and air-transport services in world-wide locations.

Among other material, the book contains information about the history and development of aviation, record flights, sporting flight events, history and organization of the Royal Air Force, aviation in the first World War, aerobatics, flying clubs and schools, and air licenses.

Control of Electric Motors, by Paisley B. Harwood; John Wiley and Sons, Inc., New York, 1944; 479 pages, $5.00.

The second edition of a book describing the characteristics of various types of motors and explaining how these characteristics are used for control purposes. The design, construction, and operating characteristics of controllers and control devices are discussed. New chapters have been added on synchronous-motor control and variable-voltage control. Additional tables giving the ratings of motors and controllers are included.

Bases Overseas, by George Weller; Harcourt, Brace and Company, New York, 1944; 434 pages, $3.50.

Many persons who believe that overseas air bases will be one of the best guarantees of peace will find this book of especial interest. It is provocative since the author is a newspaperman of wide experience who writes fearlessly and from personal observation.

Beginning with a review of the division and mandating of German and Turkish dependencies after the first World War, he criticizes the American policy of refusing to accept the responsibility of territorial gains, with the result that the nation had to expend many lives and much material to conquer them later.

The word "imperialism" has always been used in this country in the derogatory sense, but Weller believes that the time has come when the United States should take its share in bases even though it does not take title to the land on which the base is located. The difference between our philosophy of war and that of other countries is explained in great detail. Our whole idea is to achieve military victory and to let the political victory go to others.

The principal thesis of the book is that the United States should no longer rely on other countries to act as buffer states at the commencement of hostilities. As a part of the settlement of the present war, this nation should acquire bases all over the world and have these bases ready to enforce peace whenever an emergency arises, without waiting for action by others.

Air Gunner, by Sgts. Bud Hutton and Andy Rooney; Farrar & Rinehart, Inc., New York, 1944; 236 pages, $2.50.

These "natural story tellers" take the reader into the minds of aerial gunners and let him experience their feelings of hope, fear, and success. It is written from the enlisted man's point of view, and therefore is more concerned with life in a bombing plane than with broad strategy or tactics.

All the characters in the book are aerial gunners, whom the two sergeants who wrote the book believe to be the finest people in the world. They operate over Europe and have experiences that have never happened before in warfare.

The gunners know how to tell about themselves and their friends. They have a sense of humor that helps them to overcome the sadness induced by the presence of death all around them. It is a book that will bring the war in the air closer to the reader than do most of the books written about this world conflagration.

Flying Leathernecks, by Capts. Richard G. Hubler and John A. DeChant; Doubleday Doran & Company, Inc., New York, 1944; 225 pages, $2.50.

The record of Marine Corps aviation in action during 1941 and 1942 is given by two captains who served with the gallant pilots of this advanced fighting force.

This book is the factual account of how Marine fliers shot down more than 800 of the total of slightly more than 1,200 enemy aircraft destroyed in the South Pacific between August 20, 1942, and the fall of Munda less than a year later. Wake and Midway added at least 75 more to this number.

From the reduction of Guadalcanal to the occupation of Munda the achievements of Marine aviation in the South Pacific abound with feats of pilots who have become nationally famous and of squadrons that have brought everlasting credit to this branch of the Navy.

The book is written with pride in every line. Although no such book can be termed official, its pages give evidence of careful checking and personal observation. The chapters will be read by Marines now and in the future as evidence of the gallant spirit of the Corps. They will be read by those who believe in the demonstrated and potential power of air force as confirming their opinions. They will be read by the public who are thrilled by front-line anecdotes, personality sketches, first-hand accounts of aerial combat, and the air victories over our enemies.

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CARBURETORS AND ACCESSORIES

Never a Dull Moment, by Charles Frances Coe; Hastings House, New York, 1933; 326 pages, $3.00.

This well-known writer, author of many books and short stories, tells the story of his life and of the interesting people he has known. Among these are Eddie Rickenbacker, Jimmie Doolittle, and Grover Loening. He gives the opinion of the leading American ace in World War I, relative to his many medals and decorations: "It would be a better world if nobody ever got a medal . . . Medals make cannon fodder. I've seen it. I know."

He tells of a flight with Doolittle, whom he places at the top of his list of fliers. Grover Loening gained his admiration not only because of his engineering ability and love of flying, but because of his philosophical attitude toward aviation and its future.

Mediterranean Sweep, by Major Richard Thruelsen and Lt. Elliott Arnold; Duell, Sloan and Pearce, New York, 1944; 278 pages, $3.00.

Written by two officers of the Mediterranean Allied Air Forces, this book relates what they consider the best stories of the air fighting in that area. It is not a conventional history but a collection of true stories from one of the most colorful air campaigns in history. Its purpose is to give those at home some of the memorable stories the period produced.

The stories are about American, English, French, and Yugoslav pilots. Of especial interest is the description of the transformation of English Wellington bombers into magnetic-mine sweepers and the success they had in clearing the sea of these dangerous devices.

The experiences of General Taylor and Colonel Gardiner during their hazardous trip to Rome to negotiate an armistice with Marshal Badoglio will give historians material for their chapters on the Italian surrender.

The selection of exploits is excellent, each story giving the reader more than a thrilling tale. An effort is made to weave into the experiences information about how an air force operates and how its pilots and crews behave in critical situations.

Death Was Our Escort, by Lt. Comdr. Ernest G. Vetter; Prentice-Hall, Inc., New York, 1944; 323 pages, $3.00.

This is the story of a Texas boy who was determined to become a pilot. Because he was too late to be trained for the Army Air Forces, he became a naval officer and had wide experiences with the PT boats in the South Pacific. Lt. (j.g.) Edward T. Hamilton had taken flying instruction from a friend before joining the Navy. At present, after his experiences on water, he is a flight instructor at the Naval Air Station at Dallas.

Although the author centers the story around Hamilton, it could be that of any of the men who are fighting in the Pacific war area. The stories of the personnel who serve with the hero of the book are selected to broaden the related experiences. The men go with him on missions of danger and relax while visiting the various quiet stations between exploits.

It is a readable book, written in the first person, that gives an intimate view of the life of junior naval officers on the islands of the Pacific.

How Planes Get There, by Dickey Meyer; Harper & Brothers, New York, 1944; 54 pages, $1.00.

Planes in Action, by Dickey Meyer; Harper & Brothers, New York, 1944; 64 pages, $1.00.

These books are two more additions to Young America's Aviation Library, the others being "Parts of Planes" and "Types of Planes." Written simply and illustrated by clearly understood drawings, they give an explanation of flight to the younger generation, which is looking forward to the air age with the hope of personal participation.

One of the books gives the rudiments of aerial navigation and the other describes the operation of airplanes from take-off to the intricate maneuvers required in aerobatics. Both will increase the interest of any boy or girl in flying.

Where Away, by George Sessions Perry and Isabel Leighton; Whittlesey House, McGraw-Hill Book Company, Inc., New York, 1944; 249 pages, $2.75.

The "U.S.S. Marblehead," badly damaged by enemy bombs in the South Pacific, was temporarily repaired and finally made port at New York. This book is the story of this famous light cruiser, its officers, and its crew.

It is an epic of sea versus air combat. The ship came through with great credit.

Every book about this new element in naval warfare provides more evidence for those who are charged with evaluating the place of the ship and the airplane in combat areas.

Damned to Glory, by Col. Robert L. Scott, Jr.; Charles Scribner's Sons, New York, 1944; 228 pages, $2.50.

In this book, written by the author of that remarkable book "God Is My Co-Pilot," Colonel Scott turns from telling of his own experiences to relating the exploits of other pilots in many areas where air combat is making history. The great pilot writes not only with force and vividness, but puts into the stories the expert knowledge he has gained from actual experience of how pilots react under the most critical circumstances.

His stories extend from the Philippines to the Aleutians and to China and North Africa. Each incident was selected for its portrayal of outstanding valor. He pays a tribute to the workers in the aircraft factories and lets them know that without the products they have fabricated men like Dyess, Putnam, Cochran, Mahoney, and Caldwell could not have scored their amazing successes against vastly superior numbers of the enemy.

The 15 stories are written to show what pilots flying the P-40 accomplished. They make this famous plane the heroine of the book.

United States Service Symbols, by Cleveland H. Smith and Gertrude R. Taylor; Duell, Sloan and Pearce, Inc., New York, 1942; 116 pages, $1.50.

The growth of the number of insignia given to officers and men of our armed forces is bewildering to the average person. Civilians will welcome a book such as this that not only shows practically all such decorations, badges, rank and service insignia, sleeve patches, etc., but gives short descriptions of how they originated and who may wear them.

The 1,200 illustrations, many in color, will familiarize the reader with insignia so that he can place the rank, honors, and service of any military, naval, or other service men he meets. Much other useful information about our flag, correspondence with service men, and the various service branches give the book a broad utility to anyone in or out of the service.

Wings Over Burma, by Kenneth Hemingway; Quality Press, Ltd., London, 1944; 192 pages, 15s.

The author was an R.A.F. pilot who flew throughout the Burma campaign. In this book he gives a vivid impression of the fighting in the air that preceded the evacuation of Rangoon. He relates many personal experiences and tells of the exploits of many of his fellow pilots.

The book will give an excellent idea of life in an R.A.F. squadron amid primitive conditions. It is essentially the story of individual combat, a phase of aviation that may pass with this war.

The Story of Aircraft, by Chelsea Fraser; Thomas Y. Crowell Company, New York, 1944; 592 pages, $2.50.

This history of aeronautics is a new edition of an earlier book, with revisions and additions which bring it into line with recent developments. The author states that he secured his information from books, "magazines, newspapers, and prominent flying men." The book, however, contains some statements that more careful research would have corrected.

The first half of the book is devoted to lighter-than-air and parachute developments. Unfortunately, the author is evidently unfamiliar with the history of aeronautics in the United States before 1900, for almost all of his chapters are about European achievements.

In his account of the events leading up to the work of the Wright Brothers much of the information is debatable, and until a definite history of aeronautics is written without nationalistic or personal prejudice the same opinions will be expressed.

The descriptions of the work of the Wrights, Langley, and Curtiss will not be accepted without criticism by those who have had access to original documents. From that point on the book is a readable story of the use of the airplane in war and peace.

Mustangs on the Warpath

The forward element is peeling off. The other half of the squadron will fly formation during the attack, providing top cover. That's how P-51 Mustangs take to the warpath over Burma. And what a hunting ground it has been. Hunting with everything from bazookas to 500 pound depth charges and 1,000 pound demolition bombs, Mustang pilots have forced the Jap in Burma to move furtively at night and to hide in the jungle during the day.

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PLANES THAT MAKE HEADLINES... *the P-51 Mustang fighter (A-36 fighter-bomber), B-25 and PBJ Mitchell bomber, AT-6 and SNJ Texan combat trainer. North American Aviation, Inc. Member, Aircraft War Production Council, Inc.*

The Gentlemen Talk of Peace, by William B. Ziff; The Macmillan Company, New York, 1944; 530 pages, $3.00.

Those who read "The Coming Battle of Germany" know how persuasively and forcefully Mr. Ziff writes. He served in World War I with the 202nd Aero Squadron, after which he spent several years abroad studying international affairs. Another book, "The Rape of Palestine," indicates the breadth of his interests.

This book gives the results of his study of the political, economic, social, and racial problems facing the world. Almost every page is challenging and, therefore, stimulating as a study of the many difficulties that will be encountered when peace comes. To give even an impression of the author's strong opinions expressed in over 500 pages is impossible in any review. The book will undoubtedly arouse criticism here and abroad because it deals with subjects being debated by many groups.

No one can read the book without coming to the realization that the settlement of world problems is not to come from any one great international conference, but will require much greater social reorganization than can be accomplished by statesmen and diplomats.

The German Army, by Herbert Rosinski; The Infantry Journal, Washington, 1944; 220 pages, $2.00.

There is little about the Luftwaffe in this brief history of how the German military forces developed from the time of Frederick the Great. However, it does describe how the leaders in Germany surmounted the restrictions of the Treaty of Versailles and organized an air force that was later to become independent of the Army while remaining under a Supreme Command. In 1935, Goering proclaimed the reestablishment of the Luftwaffe and started the organization of an air force that has changed so many theories of warfare.

The book gives the German theory of strategy and tactics that has been carried over into the Luftwaffe. Now that the war has reached a point where armies are confronting armies, this book will be useful in acquainting our strategists with the organization and operation of the enemy's ground forces.

Teamwork and Labor Turnover in the Aircraft Industry of Southern California, by Elton Mayo and George F. F. Lombard; Harvard University Graduate School of Business Administration, Boston, 1944; 30 pages, $1.00.

This study by the Graduate School of Business Administration of Harvard University is the second in the series. The other study was about material management. The research work was done in nine aircraft factories in Southern California, and the study presents conclusions that will interest all those who wish to improve their relations with labor. The problems of teamwork, labor turnover, and absenteeism are special neither to the aircraft industry nor to war production. They are human problems met in every industry, in peacetime as well as in time of war.

The study was made in the actual industrial environment, with a conviction that solutions of human relationships are as possible as those of technology and work organization. The conclusions reached are that a greater emphasis on teamwork is desirable. How this may be accomplished and the evidences of its success are given by charts and statistics obtained by observation.

It is a brochure that anyone having to do with the management of labor will find of challenging interest.

A Bibliography of Aviation Medicine Supplement, by Phebe Margaret Hoff, Ebbe Curtis Hoff, and John Farquhar Fulton; Charles C. Thomas, Springfield, Ohio, 1944; 109 pages, $2.50.

There is no science related to aeronautics that has had such an exhaustive bibliography compiled for its guidance as aeromedicine. Under the direction of Doctor Fulton of Yale the first bibliography was published. Earlier, the Institute of the Aeronautical Sciences had issued a Bibliography of Aviation Medicine which, while useful, was not critical.

During the 2 years since the first volume was published the literature on the subject has expanded at a rate proportionate to the growth of our air strength. To keep medical officers abreast of current practice, the Committee on Aviation Medicine of the National Research Council has published this supplement, which could well be used as an example of what should be done in other aeronautical fields.

Combat in the Air, selected by Maude Owens Walters; D. Appleton-Century Company, Inc., New York, 1944; 275 pages, $2.75.

This book is a collection of stories of air force combat in France, North Africa, the Pacific, and other war areas, written by men who can select exploits of outstanding importance and describe them with the great skill of experienced writers.

The compiler has chosen from leading periodicals a group of what she considered exceptionally meritorious articles, and has made a most interesting book of them. They are dramatic and realistic and represent many phases of the war in the air. It will be another memorial to the men who fly.

Helldiver Squadron, by Robert Olds; Dodd, Mead & Company, New York, 1944; 225 pages, $3.00.

Carrier Bombing Squadron 17 made a record that is notable. The author has given its history so that the reader becomes acquainted with the pilots.

The name of the aircraft carrier from which the squadron flew may not be revealed as yet, but it saw long and continuous service in the South Pacific. The 103 days of action are crowded with exploits that reflect great credit on naval aviation. The book shows how the Japs are being driven back across the Pacific, and will give the public a better idea of life on an aircraft carrier.

Bombers' Battle, by a Wing Commander; Duckworth, London, 1943; 220 pages, 10*s.* 6*d.*

It is too early to evaluate the full effects of bombing on enemy objectives but the results of this new military offensive and its efficiency are now becoming clearer.

In this book the anonymous author, with the official blessing of Air Marshal Sir Arthur Harris, gives a carefully prepared analysis of the origin, development, and actual practice of bombing as used by the British and American air forces in this war. In addition to his own observations he includes many quotations from bombing pilots and crew members to give practical instances of the special problem he is considering.

The much-criticized leaflet-dropping early in the war is given new meaning when it is shown how valuable the reconnaissance and propaganda results of the effort were.

The final proof of the efficacy of strategic bombing can come only when the enemy goes into battle deficient in some weapon that he would have had if the factory in which it was to be made had not been destroyed.

The record of strategic and tactical bombing is given only up to the spring of 1942, but even by then the potentialities of this new force had been demonstrated.

Pilots Also Pray, by Lt. Tom Harmon; Thomas Y. Crowell Company, New York, 1944; 184 pages, $2.50.

The autobiography of this famous Michigan football player contains the story of two escapes from death that can only be described as miraculous.

Enlisting in the Army Air Corps, he went through the usual training routine and was assigned to a B-25, which he christened "Little Butch." On his flight to North Africa, as the world knows, the machine crashed and he made his way back to Cayenne, French Guiana, after days of hardship that would have overcome a less strong man.

Later he joined General Chennault's forces in China and there again, after several missions, was shot down, this time by a Jap Zero. After 32 days of privation he was again back with his squadron.

The book gives an excellent account of air combat in China and is an inspirational narrative of the daring and courage of Army Air Forces pilots.

The Sugar Creek Gang Flies to Cuba, by Paul Hutchens; Wm. B. Eerdmans Publishing Company, Grand Rapids, Mich., 1944; 89 pages, $0.60.

This book weaves a story around a flight to Cuba by a group of boys, relating their experiences while in Havana and in the back country. It should interest teen-age readers.

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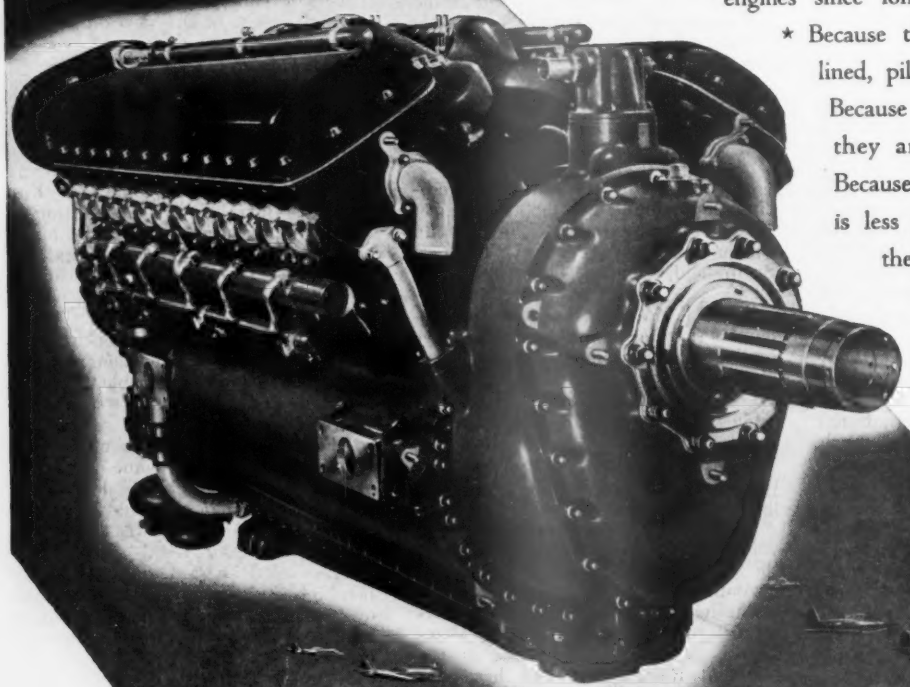

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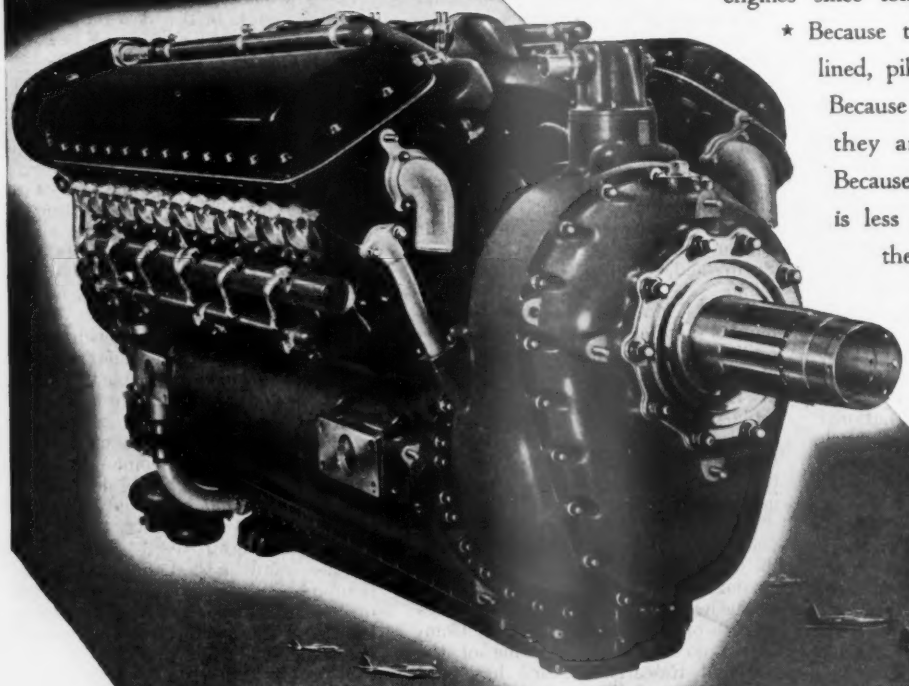

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Table for Converting Rectangular to Polar Co-Ordinates, by J. C. P. Miller; Dover Publications, New York, 1944; 16 pages, $0.76.

These tables have been developed for the purpose of facilitating the conversion of rectangular coordinates to polar coordinates by means of a given mathematical relationship as explained in the text. They are intended for use with a calculating machine or slide rule. The arrangement adopted is stated to be the result of several years of experiment. Detailed instructions are given for methods of use with a calculating machine and with a slide rule.

Introductory Aeronautics, by Clarence A. Hammond, Jr., and Harry H. Gilbert, edited by William L. Schaaf; Oxford Book Company, New York, 1944; 275 pages, $1.00.

This, one of the series of Oxford Technical Handbooks, is a handbook on the fundamentals of aeronautics written to meet the requirements of a 1-year course in the principles of aviation, airplane mechanics, meteorology, and avigation. It is intended for beginning students and contains material that will adequately serve as a basis for further study. One feature of the book is a graded series of practical flight problems. Each chapter is followed by a list of questions.

Die Federn—Ihre Gestaltung und Berechnung (Springs—Their Shape and Calculation), by Siegfried Gross and Ernst Lehr, under the supervision of Paul Speer; VDI-Verlag, Berlin, 1938; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 136 pages, $4.75.

This book contains a report of the results of studies made by the authors of correct methods for the calculation of springs, based on uniform points of view, and published in a form intended to meet practical requirements. The functions of springs in engineering are reviewed. The tendency toward lightweight construction showed that simple approximation formulas were no longer sufficient, but that it was imperative to know the actual stress distribution.

Furthermore, practical experience proved that strength of materials rather than static strength values must be used as the basis of the calculation. The same considerations governing engine construction in general are to be applied to the calculation of springs.

To replace the approximation equations that heretofore have been used exclusively, calculation methods are developed to provide accurate measurements of the actual magnitude of the stresses. This is stated to be the only way to overcome the difficulty involved in the solution of modern spring problems.

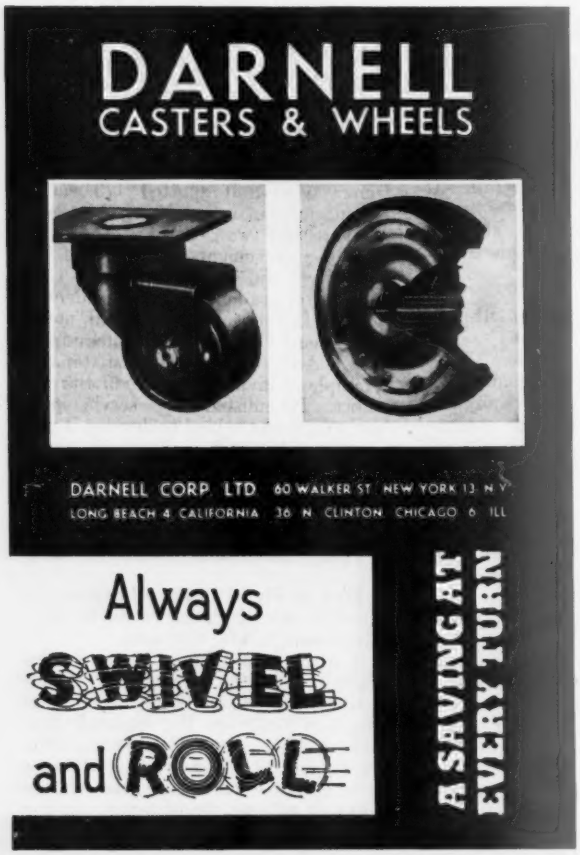
Light, Vision, and Seeing, by Matthew Luckiesh; D. Van Nostrand Company, Inc., New York, 1944; 323 pages, $4.50.

This is the second printing of a simplified presentation of the relationships between light, vision, and seeing and their importance in human efficiency and welfare.

The concluding chapter comprises 100 questions and answers on eyesight and vision, light and brightness, light and color, daylight outdoors and indoors, and light and lighting. Diagrams, charts, and photographs illustrate the text.

Theorie und Anwendung der Laplace-Transformation (Theory and Application of the Laplace Transformation), by Gustav Doetsch; Verlag von Julius Springer, Berlin, 1937; published and distributed in the public interest by authority of the Alien Property Custodian by Dover Publications, New York, 1943; 439 pages, $3.75.

An American edition of a book explaining the use of the Laplace transformation for solving problems in aeronautics, electrical engineering, electronics, radio, and physics. It contains a table of transforms of functions, together with half-planes of convergence. Included in this edition is a German-English glossary of technical terms used in the volume.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The Book of the Stars, by Louis Sutherland; Bernard Ackerman, Inc., New York, 1944; 230 pages, $3.00.

The author makes astronomy interesting to the layman, particularly young people, by telling the stories of epochal events related to the stars, and the myths and legends on which the ancient peoples based their names of the constellations. He divides his discussion into chapters on the twelve famous constellations; the group known as the Zodiac; the solar system comprising the sun, moon, and planets; and phenomena of the skies.

Man's conquest of the skies has not been achieved by the airplane exclusively. The telescope has been equally important in giving knowledge of the outer regions of space. Written in simple language, the book will give those who have to do with air navigation a romantic idea of the stars they use with such practical success.

Metallographie des Magnesiums und seiner technischen Legierungen (Metallography of Magnesium and Its Technical Alloys), by Walter Bulian and Eberhard Fahrenhorst; Springer-Verlag, Berlin, 1942; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 110 pages, $4.75.

From a collection of photographs of microscopic specimens of pure magnesium and magnesium alloys, the authors selected about 250 and used them in connection with the explanatory text of this book. They attempt to solve a series of problems in a purely microscopic way, and do not take into consideration anything that cannot be directly explained by the microscopic picture of the specimens. Instead, they refer to the book "Magnesium und seine Legierungen" (Magnesium and Its Alloys) by A. Beck, which treats the entire technology of magnesium. For the same reason they refrain from reproducing the solidification diagrams of magnesium, since these diagrams have been fully explained in Beck's book, as well as in M. Hansen's "Der Aufbau der Zweistofflegierungen" (Structure of Binary Alloys).

Sections of this book are as follows: Methods for Grinding and Deliberate Corrosion; Crystal Types; Pure Magnesium and Alloys which do not Contain Aluminum; Magnesium Alloys Containing Aluminum and Zinc; Deliberate Macrocorrosion and Structure of Fracture.

Plastic Molding and Plant Management, by D. A. Dearle; Chemical Publishing Company, Inc., Brooklyn, N.Y., 1944; 196 pages, $3.50.

The technique of compression and injection molding is described in this book, and solutions to production and managerial problems in the plastics industry are also given. Various aspects of die design, costs, and suitability of materials and methods are discussed. Consideration is given to future trends in the industry. The book is intended particularly for executives and engineers, but should be useful to foremen, specialized workmen, and students of the plastic industry.

Metallurgical Experiments, by F. Johnson; Paul Elek (Publishers) Ltd., London, 1944; 80 pages, 5*s*.

Experiments covering iron, steel, and nonferrous metals are described in this booklet. The experiments are intended to supplement instruction given in the lecture room and to furnish the student with self-obtained evidence of the chemical reactions, physical changes, and properties on which the manufacture and application of metals and alloys depend. Experiments on the precious metals, which constitute a special branch, are excluded.

Funktionentafeln mit Formeln und Kurven (Tables of Functions with Formulas and Curves), by Eugene Jahnke and Fritz Emde; published and distributed in the public interest by authority of the Alien Property Custodian by Dover Publications, New York, 1943; 379 pages, $3.50.

A new and enlarged American edition of a German compilation of tables of functions, with formulas and curves, of value as a computing aid in the solving of problems in mathematics, physics, and engineering. It is particularly intended for those engaged in practical computations involving the higher functions. Included in this third edition is a special 76-page section containing tables and formulas for the elementary functions.

Production Control in the Small Factory; British Standards Institution, London, 1944; 26 pages, 2*s*.

This is the second of a series of three booklets dealing with production control produced with the approval of the Ministry of Production. Production-control technique in the small factory is described and emphasis is placed on its importance where production must be economically increased and waste of time and effort eliminated. Sections of the booklet deal with the control of the issue of quotations, purchasing, the control of the flow and volume of work, production instructions, timekeeping, and costs. Also included are specimen schedules, cards, record sheets, and an order-flow chart.

Symposium on Plastics; American Society for Testing Materials, Philadelphia, 1944; 200 pages, $1.75.

Sixteen technical papers presented at the American Society of Testing Materials symposium on plastics are contained in this book. They deal with important problems in the field of plastics. Included is a summary of the properties, uses, and salient features of families of plastics.

Ordinary Differential Equations, by E. L. Ince; Dover Publications, New York, 1944; 558 pages, $3.75.

The first American edition of an English book on differential equations, which undertakes to discuss not merely the body of theory now regarded as classical, but also tests the main developments that have taken place in the last quarter of a century. It represents an extensive treatment of ordinary differential equations, the theory of boundary value problems, nonlinear equations, the solution of differential equations in series, oscillation theorems, and numerical methods of solution. The book is intended to be especially useful to engineers and those working in pure and applied mathematics and physical science.

Applied Fundamentals of Machines, by Wendell H. Cornetet and Daniel W. Fox; McKnight & McKnight, Bloomington, Ill., 1944; 323 pages, $2.50.

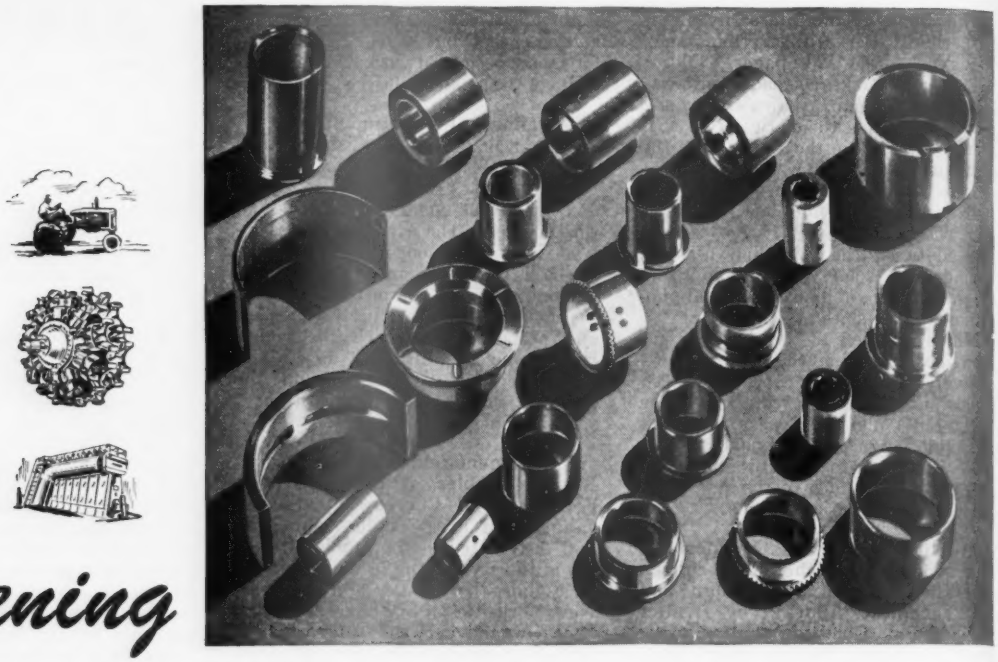
The basic principles of machines as applied to modern life are set forth in this combined textbook, laboratory manual, and notebook. Important industrial applications of fundamental theories are shown by means of experiments and demonstrations. The material is organized into units of study with page references given to many standard texts. There are also assignment units to instruct the student in the proper method of procedure for each job encountered. Objective tests on various phases of the course and a comprehensive test referring to the entire unit are included in a supplement.

Practical Manual of E-6B Computer, by Elmer F. Degon and Allan C. Zweng; Pan American Navigation Service, North Hollywood, Calif., 1944; 124 pages, $2.00.

The purpose of this manual is to explain the application of the Dalton E-6B type of computer to major and minor problems of navigation as they concern the airman. An original step method is used to illustrate the different problem methods so that the airmen can easily learn to be rapid and accurate with both the vector and the slide-rule problems. Problems are given for practice; these should be worked out and compared with the answers.

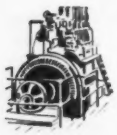
The Technological Outlook in Packaging; American Management Association, New York, 1944; 39 pages, $0.75.

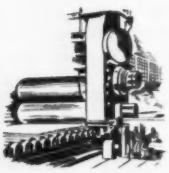
This booklet contains four papers on the general subject of packaging, which were presented at the Packaging Conference of the American Management Association held in Chicago, March 28–30, 1944. One of these is titled "Packaging for Air Cargo Shipments," by Melvin D. Miller. The changes in packaging methods that will be brought about by the expansion of air-cargo transport are discussed, and the advantages of air shipment are outlined. Attention is given to reducing the weight of packages, factors to be taken into consideration in planning the strength of packages, and problems connected with the air shipment of perishable goods. How air transportation will broaden the opportunity to combine advertising with packaging is discussed.



Opening

A New Chapter in the History of Bearings





IN a few short years, silver has added a complete new chapter to the history of bearings.

Applied by the Mallory electroplating process . . . used in nearly every American fighting plane . . . silver has smoothed the way to seven-mile-a-minute speeds and thousands of revolutions per minute. Here it fights friction and heat . . . withstands crushing pressures and stresses . . . permits tolerances to 2/10,000 of an inch, and surface finishes measured in millionths of an inch.

But there are many other applications to which Mallory precision bearings are ideally suited—and other materials of which they are made. The list of products tabulated below is merely suggestive of their adaptability.

The point is that as Mallory precision bearings continue to be made, the Mallory program of research goes on and on. Improvements are being discovered continuously. New metals are being developed—some for heavy duty, others for light. Not least important, Mallory has established new and economical methods of producing precision bearings, in quantity, and final costs have been greatly reduced.

Nobody knows where the chapter will end. But wherever precision bearings must absorb unusual loads, stand up under high speeds, improve efficiency and performance—there Mallory experience will serve you well. Call on our engineers for assistance. They're ready to help you—*anytime.*

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FOR AIR COMPRESSORS • AIRCRAFT, AUTOMOTIVE AND DIESEL ENGINES • ELECTRIC GENERATORS AND MOTORS • ELEVATORS • FANS AND BLOWERS • GOVERNORS • HOME APPLIANCES • MACHINE TOOLS • PUMPS • RAILROAD EQUIPMENT • ROLLING MILLS • STATIONARY AND PORTABLE ENGINES • STOKERS • TURBINES

Technologie des Holzes (Technology of Wood), by F. Kollmann; Verlag von Julius Springer, Berlin, 1936; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 764 pages, $23.50.

This book is intended for readers who are interested in the technology of such a complicated material as wood. The author states that he has attempted to give a clear technical representation based on the results of the latest investigations of wood. In doing so he found that theoretic considerations confirmed the most important experiences in practical application. As a starting point for these considerations he selected the micellar structure, because this structure gives a clear explanation of the anisotropy of wood. The micellar structure theory also proved helpful in interpreting various phenomena in relation to one another.

The most important ideas and facts are presented in two of the largest chapters of the book, dealing with the physics and chemistry of wood. In order to show the close interrelation of theory and practice, calculation examples occasionally appear in the text. No expert knowledge of the subject matter is necessary, for new conceptions are discussed in a nontechnical manner.

The contents are as follows: Structure of Wood; Physics of Wood; Elasticity and Strength of Wood; Chemistry of Wood; Preservation and Drying of Wood; Machining of Wood; Nondestructive Shaping of Wood and Wood Combinations; Refining of Wood; Utilization of Waste Wood.

Dehnungsmessungen und ihre Auswertung (Expansion Measurements and Their Evaluation), by F. Roetscher and R. Jaschke; Verlag von Julius Springer, Berlin, 1939; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 121 pages, $4.10.

The purpose of this book is to facilitate the application of expansion-measuring methods. It is stated that the book was the result of the remark that the principal expansions may be determined from the measured expansions by means of a deformation circle. The authors thereupon developed a series of simple methods to evaluate these measurements, and applied them first to uniaxial and biaxial and then to triaxial deformation and stress conditions.

The investigations are supplemented by descriptions of some characteristic extensometers and by discussions of the combination of two-dimensional stress systems. They also deal with the determination of expansion within walls and with the representation of deformation and stress conditions. Special attention has been given to the achievement of a clear representation and to the elementary form in which the formulas are made up. Their application is shown by many examples. These investigations give information concerning the mechanics of the deformation of elastic bodies and are a contribution to the knowledge of the strength theory.

High-Speed Combustion Engines, by P. M. Heldt; P. M. Heldt, Nyack, N.Y., 1944; 776 pages, $7.50.

This is the twelfth edition of a text and reference book for automotive engineers, which was originally published in 1912 under the title "The Gasoline Motor." The text has been completely revised and a considerable amount of new material has been added, particularly in the chapters on the production of engine blocks, the connecting rod, crankshafts and flywheels, valve-actuating mechanism, water cooling, air cooling, manifolds and mufflers, and engine tests. The chapter on so-called unconventional engines, which first appeared in the eleventh edition, is continued.

Although the book does not refer to aircraft engines directly, it deals with many problems that are common to both automotive and aircraft engines.

(*Continued from page 51*)

ica, or other suitable location will be considered. Address inquiries to Box 259, Institute of the Aeronautical Sciences.

Structural Aeronautical Engineer—Extensive experience in military and commercial aircraft development, and as design project engineer, desires responsible engineering position in air cargo development, or other postwar project in eastern or northeastern area. Release available, draft exempt. Address inquiries to Box 258, Institute of the Aeronautical Sciences.

Industrial Engineer—Broad and varied experience in Plant Layout, Tool Design, Tool Control, Methods, Procedures, Hours Control, Work Simplification, Cost Analyzation, Incentives and Reports. Wants responsible position; can go anywhere; now employed; can comply with W.M.C. Regulations. Address inquiries to Box 256, Institute of the Aeronautical Sciences.

Graduate Aeronautical Engineer—Two years with World Airline in South America, 3 years with a senior world aircraft manufacturer, desires position requiring tactful exercise of initiative and resourcefulness as assistant export sales executive; speaks Spanish and Portuguese fluently; travel anywhere. Address inquiries to Box 255, Institute of the Aeronautical Sciences.

Aircraft Engineer—Nine years in active aircraft operations, including two years loftsman, one year liaison engineer, one year supervisor of production engineering, two years engineering representative for all subcontracted parts of large West Coast manufacturer, one year research and development engineer for Rocky Mountain firm. All W.M.C. affidavits approved. Desires position of engineering trouble-shooting or representation, preferably foreign and tropical. Will also consider any reasonable Southern California offer. Address inquiries to Box 253, Institute of the Aeronautical Sciences.

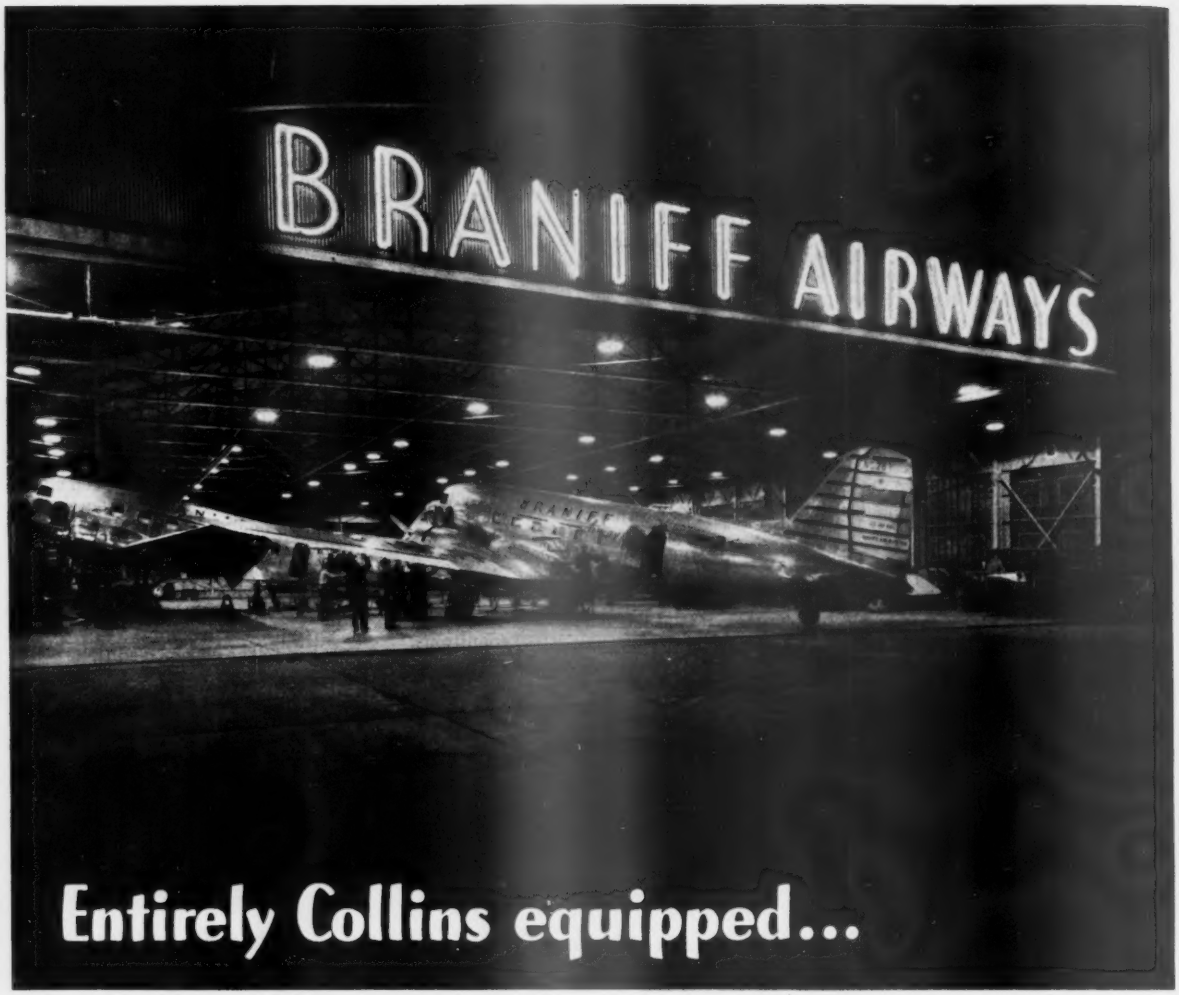
Aeronautical Engineer—B.S. and M.S. degrees. Nine years' experience in structures, wind-tunnel testing weights, and flight testing. Have been chief of structures for three well-known manufacturers. Desire commensurate position with company having postwar possibilities. Address inquiries to Box 251, Institute of the Aeronautical Sciences.

Aeronautical Development Engineer—College graduate with six years' experience in design and development of commercial and military airplanes desires responsible position in small concern in executive or development capacity. Capable of taking complete charge of new projects. Present position, project engineer. Would consider air-line work. Address inquiries to Box 250, Institute of the Aeronautical Sciences.

Mechanical-Aeronautical Engineer—5 years, major aircraft stress analysis. Desires connection with west coast airframe or accessories company. Address inquiries to Box 244, Institute of the Aeronautical Sciences.

Inspector and Quality Control Engineer—Five years' experience with high-altitude fighter planes, desires employment with an air line. B.S. degree; speaks three foreign languages fluently; any location. Address inquiries to Box 237, Institute of the Aeronautical Sciences.

Consultant Aeronautical Engineer—Honorably discharged Army Air Forces, formerly executive Chief Engineer, Administrator, Designer desires new connections or additional consultant work. Preliminary aircraft design and jet propulsion specialist. Address inquiries to Box 205, Institute of the Aeronautical Sciences.



Entirely Collins equipped...

BRANIFF AIRWAYS, INC. has been using Collins ground transmitters since 1935 and Collins aircraft transmitters since 1937.

It was the first great airline to recognize the superiorities of Collins design, workmanship, and performance, the first to avail itself of the precise, sturdy, reliable Collins Autotune.*

Today Braniff uses Collins multi-channel or Autotune equipment at every point at which it has a radio station, and every ship in its *Super* B *Liner* fleet carries a Collins 17F Autotune aircraft transmitter.

There is a deep satisfaction in having supplied the nerve-system on which Braniff relies in maintaining its magnificent record of safety and operating efficiency.

When Collins turned to war production, it could apply the know-how that came from furnishing communication equipment which met the exacting needs of Braniff and other major airlines. When it returns to civilian design and production, it will add to that know-how the tremendously increased, intensified experience acquired in its services to the Armed Forces. Collins Radio Company, Cedar Rapids, Iowa.

ARMY E NAVY

*The Collins Autotune is a repositioning mechanism which quick-shifts all transmitter or receiver tuning controls simultaneously and with extreme precision to any one of a number of pre-determined frequencies. Patents issued and pending in the USA and other countries.

COLLINS

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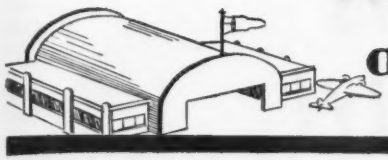
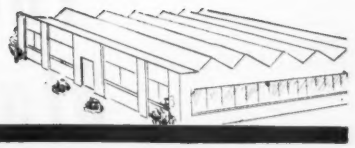
House Organs and Catalogues





Measuring Instruments

Rochester Gauges is a 4-page folder illustrating and giving brief specifications of a group of engine gages, liquid level gages, and dial thermometers. The engine gages are for indicating oil pressure, temperatures, and generator-charging rates. The liquid-level gages and dial thermometers are for use in aircraft and industrial machinery. *Rochester Manufacturing Company, Inc.*, Rochester, N.Y.

Aircraft Fastener Booklet

They Fly with Their Boots On is a small booklet that describes the features of Boots self-locking nuts for aircraft fastenings and for other uses. The advantages of this type of construction are outlined, and numerous types of vibration-resisting fastenings are illustrated. *Boots Aircraft Nut Corporation*, New Canaan, Conn.

Brazilian School for Aviation Mechanics

'Tech' School Rounds Out Brazil's Air Program. This article about the Escola Tecnica de Aviacao at Sao Paulo includes information about the establishment, organization, and courses of Brazil's technical training school for aviation mechanics. It also notes the aid of the United States in instituting the school. As related, the training program at the Escola Tecnica de Aviacao is divided into three sections: In the first stage students study theory; in the second stage they progress to general mechanics, with a large proportion of practical shop work; in the final stage each student is assigned to one of the four departments—basic, aircraft, engines, and instruments. The length of courses varies from 22 to 36 weeks. *The Pegasus*, December, 1944.

Foreign Welding Terms

Glossary of Foreign Welding Terms. The purpose of this glossary is to give the nonprofessional translator a convenient and useful means for working with foreign-language welding publications. Many of the terms contained in the glossary have been derived from various foreign technical magazines and therefore are not usually found in technical or foreign dictionaries. The subject matter is arranged in such a manner as to supplement the respective technical dictionaries rather than substitute for them. The first part is German-English, part two is French-English, part three is Russian-English, and part four is Spanish-English. *American Welding Society*, New York. $0.50.

Compilation of Catalog Sheets

The current issue of *Modern Precision* is a "General Catalog" issue in which there are assembled for the first time under one cover brief descriptions of all products of the manufacturer including measuring instruments, automatic controls, and heat-treating furnaces. The object of the publisher is to provide a comprehensive index, with specifications sufficient to identify instruments, controls, or furnaces, and to give, in connection with each instrument, a reference to other printed matter in which the devices are fully described.

The contents are arranged in three major groups: industrial measuring and control equipment, measuring instruments, and furnaces. Page references are given in an index chart. *Leeds & Northrup Company*, Philadelphia.

Bulletin on Heating of Industrial Plants

Portfolio of Outstanding Engineering in Industrial Heating describes the direct-fired warm-air method of heating and illustrates several war structures that are heated by this method. These structures include, among others, the 35-acre bomber-modification center at Birmingham, Ala.

This heating method is reported to be particularly adaptable to the aeronautical, industrial, and automotive fields in peacetime. The booklet is designated as Bulletin 512. *Dravo Corporation*, Pittsburgh.

Air-Line Growth

Mid-Continent's Development Program outlines the plans of this air-transport organization for extending its field of service and operations. It includes statistics showing the growth of its air-traffic business and of the territories served by existing and prospective routes. *Mid-Continental Airlines, Inc.*, Kansas City, Mo.

Chilean Air Line

Linea Aerea Nacional. The history of Chile's air line, Linea Aerea Nacional, is outlined. It refers to the establishment of the air service, the terrain over which it travels, the equipment it uses, the pilots who fly its aircraft, and the executives who administer its activities. It also contains reports on the company's record; the amount of passengers, mail, and cargo carried; the number of miles and hours flown; numbers of personnel employed; etc. Figures pertinent to Linea Aerea Nacional's capitalization and financial status are included. *Lockheed Log*, October, 1944.

Torque Tools

Livermont Torq-Stop Tools describes the construction and operation of torque tools for aircraft work as well as other industrial operations. The booklet also contains information about the manufacturer's Roto Torq Driver and a torque calibrator. *Richmont, Inc.*, Los Angeles.

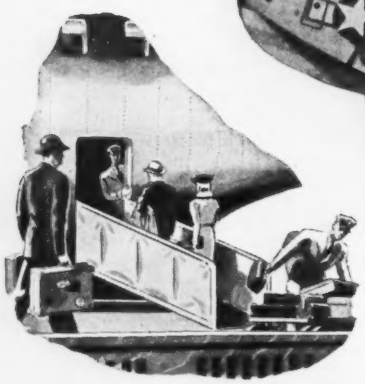
Handbook of V-Belts

V-Belt Handbook for Industrial Applications is a 74-page illustrated handbook. It discusses the operating advantages of V-belts, qualities to seek in the product, installation and care, sheaves, selection of the V-drive, and general information applicable to the whole field of power transmission by belt. It contains tables on installation and take-up allowances; a listing of five cross-section sizes and a complete variety of V-belt lengths; service factors; and a general belt-selection table. Other tables include combination groove or standard cast-iron drives, stock drives, standard drives, V-flat drives, quarter-turn drives, sheaves, belt speeds, horsepower ratings of multi-V belts, corrections for arc of contact and exact speed of driven machine, standard groove dimensions for industrial V-belt sheaves, and sheave dimensions. *The B. F. Goodrich Company.*

Resistance Welding

Resistance Welding at Work is the title of Bulletin WP-44, a 60-page, two-color book containing numerous illustrated examples of resistance-welding applications. It is intended primarily as a guide to a wide variety of uses to which resistance welding is applicable. It contains examples showing how many problems have been solved and the equipment used in a variety of industrial work. To facilitate the use of the book, the material has been arranged under five general headings in such a manner that the answer to a given general problem can be readily located. The divisions deal with portable-gun welding; stationary spot welding; and seam welding, either in machines or fixtures. There is also a section devoted to special uses to which resistance-welding equipment can be put, as well

The Martin Mars Stands for Safety!



CLIMBING ON 2 ENGINES: Demonstrating its high safety factor, the 72-ton Martin Mars gains altitude with 2 of its propellers fully feathered.

WHO will be tomorrow's overocean airline passengers? Recent surveys tell us that 45 is the approximate age at which the greatest number of airline trips are taken. Thus it seems likely that the majority of tomorrow's overocean passengers will be successful business men and middle-aged tourists who have earned the time and money to travel abroad. Older, more conservative, they will probably be swayed by considerations of safety—will undoubtedly prefer flying boats, like the Martin *Mars*, for transocean air travel.

Mars Transports Stress Safety

As a flying boat, the *Mars* possesses greater inherent safety than landplanes for extended overocean trips. Then, too, its huge size and strength give the added assurance that if forced down it could cope successfully with heavy waves. More, it has demonstrated its ability to remain aloft on only 2 engines, its wings are sufficiently thick to permit the crew to service the engines while in flight, and the most modern safety devices of every sort have been incorporated in its design. In safety, as in payload and low operating cost, the Martin *Mars* is second to none!

Tested and Proven in Service

Most important of all, the *Mars* has been tested and proven in regular transocean service with the Navy. All "bugs" have been ironed out, all findings have been incorporated in the 20 larger *Mars* transports now being built. As a result, war's end will find Martin production lines completely tooled and manned for prompt delivery of these ultra-dependable aircraft. *Airlines and shipping companies interested in information on commercial versions of the Mars,* write: THE GLENN L. MARTIN CO., BALTIMORE 3, MARYLAND

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AIRCRAFT

Builders of Dependable Aircraft Since 1909

as a section showing by examples the possibilities in large or small fixture design.

Under each of these specific headings information is given based on current practices in fabricating materials ranging from aluminum to stainless and carbon steels in sheets and heavy sections. *Progressive Welder Company*, Detroit.

Engine Gear Manufacture

Gears, the Engine's Heart. The foreman of the gear department of an aircraft engine plant describes some of the difficulties encountered in the manufacture of gears. It is pointed out that 104 machine operations are required to produce an impeller-shaft gear. Reference is made to the difference between gears for automobiles and those for airplane engines. It is noted that, unlike automobile gears, the gears for an airplane engine are not uniform—one part is thick and one part thin; one part is soft and one part hard. The importance of gear toughness for the reduction of wear is emphasized. It is stated that in operation a fixed reduction-drive gear meshes over 5,000,000 teeth every minute. Machining operations are discussed. Emphasis is placed on the importance of heat-treatment. *The Wasp Nest*, November, 1944.

Booklet About Grinding and Finishing

Step Up Production with the 3-M Method of Grinding and Finishing is a new booklet designed to provide purchasing agents, works managers, production managers, chief engineers, and plant superintendents with facts and information about speedy, economical grinding and finishing methods. It is illustrated by actual close-up shop photographs showing numerous grinding and finishing operations. It tells how 3-M abrasive backstand belts and segment-face contact wheels with bench backstand idlers, floor-model backstand idlers, swing grinders, and other high-speed units are increasing production and simplifying the maintenance of tools and equipment.

The booklet includes a formula for determining abrasive-belt sizes and placement of backstand idlers and complete data on 3-M abrasive-belt sizes and grits and segment-face contact wheels that are available to licensed users without royalty.

Three smaller booklets deal individually with the method as applied to the grinding and finishing of small parts and tools, heavy-duty grinding and finishing of small parts and tools, heavy-duty grinding and finishing of flat or curved surfaces, and the method employing a semiportable unit for grinding and conditioning raw metal stock. *Minnesota Mining and Manufacturing Company*, St. Paul.

Gages for Measuring Moisture Content

Kaydel Moisture Gauges are described in this leaflet of 12 pages. It discusses a method of measuring moisture content based upon testing the electrical resistance of the material. The material is tested by a series of six standards in the instrument, calibrated in terms of percentage of moisture. The gages are designed to measure moisture content ranging from 3 to 160 per cent. *Hart Moisture Gauges, Inc.*, New York.

Acetylene-Generator Bulletin

Airco Bulletin ADC 619-A describes and illustrates the company's complete line of acetylene gas generators, including portable models in 15-, 30-, and 50-lb. sizes with productive capacities of 30, 60, and 100 cu.ft. maximum per hour. Stationary models are available in 300- and 500-lb. sizes which deliver 300, 600, and 1,000 cu.ft. maximum per hour. *Air Reduction Company, Inc.*, New York.

Courses in Aeronautical Instruction

Parks Air College. The three Parks organizations engaged in instruction in various fields of aeronautics are described in an illustrated book of 63 pages. The facilities and services offered by Parks Air College, Parks Air Transport, Inc., and Parks Air Transport Sales and Service are mentioned. After the history and development of the Parks Air College are reviewed, information is given about the physical and mechanical facilities. This is followed by detailed descriptions of the courses of instruction given in professional flight training, aviation operations engineering, aviation maintenance engineering, aeronautical engineering, and advanced meteorology. Other sections of the book deal with the physical education and health service and the buildings and equipment provided for the students. The numerous subjects taught are outlined under appropriate headings, with brief descriptions of the scope of each subject. *Parks Air College*, East St. Louis, Ill.

Presses for Deep Drawing

H.P.M. Fastraverse presses are described briefly in a folder that oulines the scientific principles upon which these high-speed hydraulic machines are designed. *The Hydraulic Press Manufacturing Company*, Mount Gilead, Ohio.

The Story of the Scottish Airways, Ltd.

The Airways of Scotland. An outline history of Scottish Airways, Ltd. Comments are given on the background of the company, its organization, routes, equipment, conversion to wartime operations, and current activities. Attention is called particularly to the air-ambulance services of this air line. Covering the period from 1935 to 1943, a table indicates the traffic growth of Scottish Aiways and its predecessor companies in service-miles, passenger journeys, amount of freight and mail pounds carried. *The Intava World*, October, 1944.

Scribing Glass

Detail Engineers' Glass is an 8-page booklet containing information about two new types of detail engineers' glass. The first of these is a translucent glass, marked in graph squares and having a translucent vellum facing to facilitate mechanical drawing. It can be used for drawing with pen or pencil, and erasures can be made. The second development, a scribing glass, has a standard film over the graphlike detail lines that are accurately ruled on the glass. Upon it, layouts of comparator charts can be kept to scale without mathematical computations. A grade-comparator chart is also described, as well as the manufacturer's older types of translucent and scribing engineers' glass. Accompanying the booklet is a folder containing specifications and prices of charts for use with various measuring projectors and comparators. *Engineers Specialties Division, The Universal Engraving & Colorplate Company, Inc.*, Buffalo, N.Y.

Maintaining Lighting Fixtures

Hints on Lighting Maintenance is a small booklet of 26 pages containing suggestions for efficient and economical maintenance of lighting equipment. Instructions are given for cleaning fixtures, relamping, inspection and repair, with tabulated schedules and other data. Safety practices, painting, and testing are also outlined and other tables give schedules for periodic maintenance and replacement. *Westinghouse Electric & Manufacturing Company*, Cleveland.

Pneumatic Gages

Gaging with Air is a new catalog containing recent information about various models of the manufacturer's Air-O-Limit gages. It describes and illustrates internal comparators, bench-type gages, hand-type gages, and bearing gages. Specifications are tabulated. Circular No. 479. *Pratt & Whitney Division of Niles-Bement-Pond Company*, West Hartford, Conn.

Aeronautical School Facilities

Casey Jones School of Aeronautics is an illustrated brochure of 32 pages reviewing the history and describing the facilities of that organization. It sets forth the requirements for entrance, the curricula offered, and the instruction given in aeronautical vocations. In addition to courses in aeronautical engineering, the school gives instructions for aircraft mechanics and maintenance workers. Many photographs of the classrooms and shops of the school serve as illustrations. *Casey Jones School of Aeronautics*, Newark, N.J.

Test Pilot

Milo Burcham. Events in the flying career of Milo Burcham, Chief Test Pilot at Lockheed Aircraft Corporation,

G&O
Radiators
30th Year

ENGINE COOLING
RADIATORS

•

OIL COOLERS

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NEW HAVEN, CONNECTICUT

ENGINEERS

TOOLS & GAGE
MANUFACTURING PROCESS
PRODUCTION METHODS

ALSO

DESIGN ENGINEERS
SENIORS & JUNIORS

SHEET WRITERS
MANUFACTURING OPERATIONS

TOOL & GAGE DESIGNERS

TOOL & GAGE
DRAFTSMEN

PLANT LAYOUT
DRAFTSMEN

GAGE ANALYSTS

AERONAUTICAL INDUSTRIAL MFG.
EXPERIENCE ESSENTIAL

CURTISS-WRIGHT CORP.
PROPELLER DIVISION
CLIFTON & CALDWELL, N. J.

APPLY PERSONNEL OFFICE
143 GETTY AVE., CLIFTON, N.J.

are reviewed. In brief detail the chronicle follows Burcham through experiences of learning to fly, barnstorming, instructing, making record flights, stunting, ferry piloting, and test flying. *Lockheed Log*, October, 1944.

Die-Casting Equipment

Die Cast Your Product. A method of die casting and the complete assembly of equipment necessary for this work are described in a 17-page booklet. The so-called die-casting package consists of die-casting machines, accessories and equipment, and special-purpose auxiliary equipment to fit the scope of the particular work to be done. In addition to the equipment, the manufacturer offers service facilities intended to provide proper utilization of the equipment. The features of the machines are explained at length, with illustrations showing the various parts and the particular functions of each. *H. L. Harvill Manufacturing Company*, Vernon, Calif.

Aircraft Testing Equipment

Dynamics Measurement Equipment. Devices for measuring acceleration, loads, and stresses actually encountered in aircraft under representative flight conditions are described in a 4-page folder. This equipment was developed as a part of a program intended to meet the requirements of flight testing. It consists of a specially designed carrier amplifier, power supply, and various types of small remote-indicating units. The responses of a number of these devices are recorded simultaneously in permanent form on sensitized paper.

The applications of this equipment to aircraft work are outlined, and the equipment is described with the aid of drawings. *The Glenn L. Martin Company.*

Air-Equipment Installations

Bellows Photo Facts File is a folder containing numerous photographs showing installations of the manufacturer's pneumatic equipment in industrial plants throughout the United States. Each photograph is accompanied by a story of how the tool engineers solved difficult production problems. In addition to a description of each specific application, information is given about the cost of the equipment used. *The Bellows Company*, Akron, Ohio.

Plastic Surface Coatings

20 Years of Plastic Surfacing. This heavy, ring-bound book of 44 pages gives the history of the development of plastic surfacing and the application of the processes in a wide range of industrial uses. Information is given about the basic chemical ingredients and the processes by which they are prepared and applied. Such products as a colored coating of flexible lacquer for steel, brass, aluminum, and die castings; a corrosion-resistant finish; a synthetic enamel; and a type of plating enamel are described. Thermosetting enamels, primers, coating for food-container closures, and numerous other lacquers and enamels are included, with descriptions of their manufacture and use. Among the applications of these materials in aircraft work are enamels for coating aircraft aluminum and plywood, gasoline-proof lacquer, and coatings for the electrical cables of aircraft engines. *Roxalin Flexible Finishes, Inc.*, Elizabeth, N.J.

Uses of Cellulose Plastics

Why Cellulose Plastics? A 4-page folder illustrating the properties of cellulose plastics is intended for nontechnical as well as technical readers. It shows pictorially the characteristics of a selection of end products made from cellulose acetate, ethyl cellulose, and cellulose nitrate.

Cloth-laminated cargo containers, tubing that can be bent and flexed at −40°F., transparent packages, and many different colored housings for radios, telephones, and other devices provide an indication of many postwar uses for cellulose plastics.

Products illustrating the possibility of producing multiple units at high speed and various electrical uses for cellulose plastics, including wet-cell housings, are also pictured to demonstrate other properties of cellulose plastics which have been improved by research during the war and are being used by a continually increasing number of industries. *Hercules Powder Company, Cellulose Products Department*, Wilmington, Del.

Interior Arrangement Drawings for the Stratocruiser

Inside Story of the Stratocruiser. A group of drawings illustrates the interior arrangements for one of the commercial versions of the Boeing 377. This model is designed to carry 60 passengers during the day, with sleeping arrangements for 30 passengers. *Boeing Magazine*, November, 1944.

South American Air-Trade Survey

Trade Survey of South America is being distributed through accredited travel agents, for whom it was especially prepared to stimulate inter-American trade by air now and to pave the way for expanding business relations with South America after the war.

The survey is intended primarily for chambers of commerce, manufacturers' associations, boards of trade, and other organizations representing American business which are alert to the postwar possibilities of inter-American trade and which have the personnel and means to investigate these postwar potentials at this time.

The countries included in Panagra's survey are Panama, Colombia, Ecuador, Peru, Bolivia, Brazil, Chile, Argentina, and Uruguay. Opportunities for postwar commerce recently compiled by the U.S. Department of Commerce; basic trade information; trade balances; a list of major import commodities;

area and population figures; and present and proposed air services are given for each country.

The survey cites many examples where economic survey trips of South America have already been made in the interest of establishing export markets for manufacturers and selecting and establishing South American representatives for trade-relationship purposes. *Pan American-Grace Airways, Inc.*, New York.

Catalog of Fluxes

Superior Fluxes for Welding, Brazing, and Silver Soldering describes the manufacturer's complete line of fluxes. Included in the group are 20 fluxes for welding, brazing, silver soldering, soft soldering, and low-temperature alloy welding of ferrous and nonferrous metals and alloys.

Fluxes for silver soldering and similar operations are offered in both paste form and powder form. Different fluxes are available for welding, brazing, and soldering all forms and alloys of aluminum. For cast iron and copper there are both welding and brazing fluxes, and for stainless steel there are welding and soldering fluxes.

For each flux there is a detailed statement of its characteristics. The catalog has been arranged for easy selection of the correct flux for any individual application. *Superior Flux Company*, Cleveland.

Insulation Materials

Fiberglas Electrical Insulation Materials is a 23-page booklet containing data and information about the properties, forms, and applications of Fiberglas electric-insulation materials. In addition to a description of the characteristics of the material, there are sections giving detailed facts about yarns, insulated wire, tapes, cordage, braided sleevings, cloth, varnished cloth, and tape. Other sections refer to combinations of Fiberglas and mica, laminates, saturated sleeving and varnished tubing, pressure-sensitive tape, and Fiberglas and silicone resin varnishes. Tables and charts supplement the text matter. Catalog No. EI44-7, *Owens-Corning Fiberglas Corporation*, Toledo, Ohio.

Tachometers

Jones Individual Mounting Type Tachometers are described in Bulletin No. 44-1. It refers to four models of individually mounted tachometers and the multirange portable hand tachometer. It shows full-face and profile views of the individual tachometers, r.p.m. ranges available, and mounting dimensions. A section is included on the use and operation of these instruments and general data concerning their installation. *Jones Motrola Company*, Stamford, Conn.

A Steel Company's War Contribution

Republic Goes to War gives the service record of Republic Steel Corporation in its contribution to the winning of the war. It contains a review of the company's expansion of facilities in cooperation with various Government agencies and gives information about the new plants, their equipment, and products. Figures are included to show the extent of the company's production for various war purposes. *Republic Steel Corporation*, Cleveland.

Peacetime Police Force

Great Bombers to Guard the Peace. Although actual details of the scheme have not yet been published, this is a broad outline of the United Nations Security Council's plan for using air power as a means of international law enforcement. The proposed operating plan is likened to a system for "Air Precinct Stations," with each "patrol beat" functioning similarly to regular police precincts. Probable location of stations, as well as the extent of the area to be allocated to the guardianship of the United States, are discussed. Showing that bombers of the type of the B-29 and B-32 make this international patrolling possible, the article also indicates the feasibility of the operating plan as proved by the experience of the U.S. Army's 20th Air Force. *Plane Talk*, November, 1944.

Information About Latin America

Let's Get Better Acquainted is the title of a new booklet intended to promote cultural and commercial relations with Latin America. A folder titled *Aerial Trade Arteries to Latin America* is also being distributed.

Both booklets incorporate information for business men and shippers, as well as those members of the general public who are interested in Latin America. Facts and figures on areas and populations, history, climate and terrain, commercial prospects, and air express are given.

The booklet also includes information about travel opportunities, educational values, and suggestions concerning baggage, what to wear, travel funds, and necessary preliminaries for those planning a Latin American air trip. *Pan American World Airways*, New York.

Oxyacetylene Pipe-Line Installations

A new 12-page illustrated booklet gives a concise description of typical oxyacetylene pipe-line plans for various sizes of industrial plants. It discusses in detail the advantages of gas-piping systems for medium- and large-volume users of oxygen and acetylene in welding, cutting, and other flame processes. Details on pipe sizes, central depot location, station outlets, safety devices, and other pertinent data are included. Schematic diagrams of piping layouts for typical plants ranging from railroad shops to aircraft welding departments are among the topics discussed. *Air Reduction Company, Inc.*, New York.

Data on Flexible Shafts

Flexible Shaft Handbook. A new and enlarged edition of a handbook containing engineering data on flexible shafting for a wide range of applications has been issued. One section is devoted to flexible shafts for remote-control applications in aircraft. Information is also given about shafts for driving aircraft fuel pumps, aircraft instruments, and other accessories.

Data on flexible shafts for radio and electronic equipment are included. There is also information about the installation and care of flexible shafts. *The S. S. White Dental Manufacturing Company, Industrial Division*, New York.

Flying Repair Stations Service B-29's

Winged Repair Shops. An account of how four Curtiss C-46 Commandos are equipped as flying machine shops to provide on-the-spot repair service for Superfortresses in the China-Burma-India area. Information is given about the equipment carried by the air-borne repair shops, how such equipment is arranged, and the range of repair functions which the mobile units can perform. *Curtiss Fly-Leaf*, September-October, 1944.

Resistance-Welding Equipment Standards

A new booklet standardizes the nomenclature, definitions, and quality of resistance-welding equipment. A chart gives the proper electrodes to be used for spot-welding similar and dissimilar metals.

Also included are tables of equivalent ratings, limits of transformer-temperature rise, etc. *Resistance Welder Manufacturers Association*, Philadelphia.

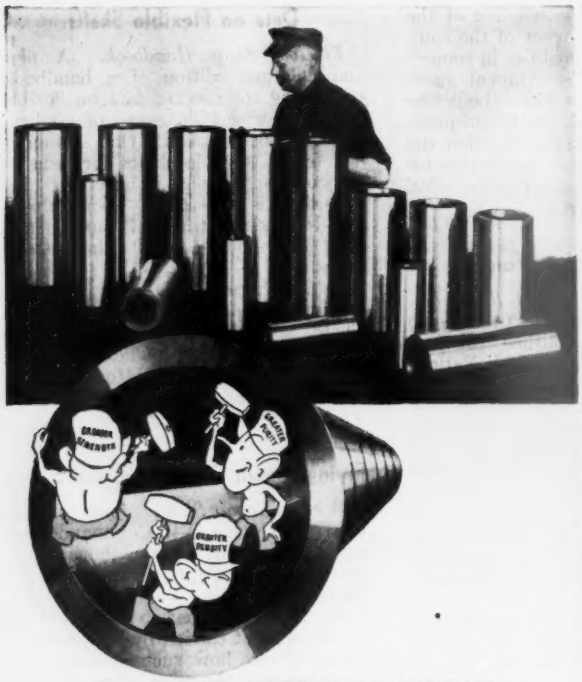
Steel Plate Fabrication

Industrial Steel Fabrication. A bulletin on steel-plate fabrication describes and illustrates equipment and services available for various industries. Among the more modern operations noted are precision shape cutting, stainless-steel welding, and plate bending on machinery that develops up to 500,000 lbs. hydraulic pressure. *Marine Fabricators Company*, Perth Amboy, N.J.

Flame-Cutting Services

The advantage of flame-cutting over friction-cutting methods on certain manufacturing operations are described in a 4-page folder.

Showing details of flame-cutting operations, the folder acts as a medium in offering industry the same type of flame-cutting service employed by the manufacturers in their own fabricating projects. Also offered are two additional services related to flame cutting and annealing and grinding. *Central Boiler and Manufacturing Company*, Detroit.



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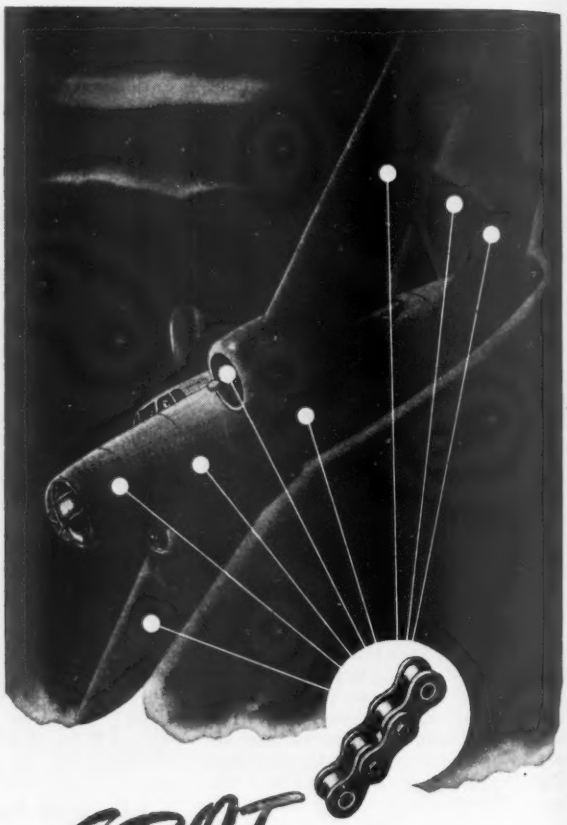

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- Retractable Landing Gear
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FOR AVIATION . . . .

X-Ray Inspection Unit

A new brochure has been published on the Norelco Geiger-Counter X-ray spectrometer. It describes the range of applications for the first Geiger-Counter focusing spectrometer to be developed. In the booklet the instrument is recommended for process control in the paint, chemical, ceramic, rubber, and metallurgic fields.

The spectrometer is said to provide a new method of making quantitative and qualitative analyses of crystalline and certain amorphous substances. Under optimum conditions of resolution, accuracy of $\pm 0.03°$ is reportedly obtainable. Descriptive material is included pertaining to the method of operation. Specifications are given for the spectrometer proper, transformers, stabilizer, scaling unit, power supply, frequency meter, impulse counter, Geiger unit, and X-ray tube. *North American Philips Company, Inc.*, New York.

Manufacturing Replacement Parts for Prewar Aircraft

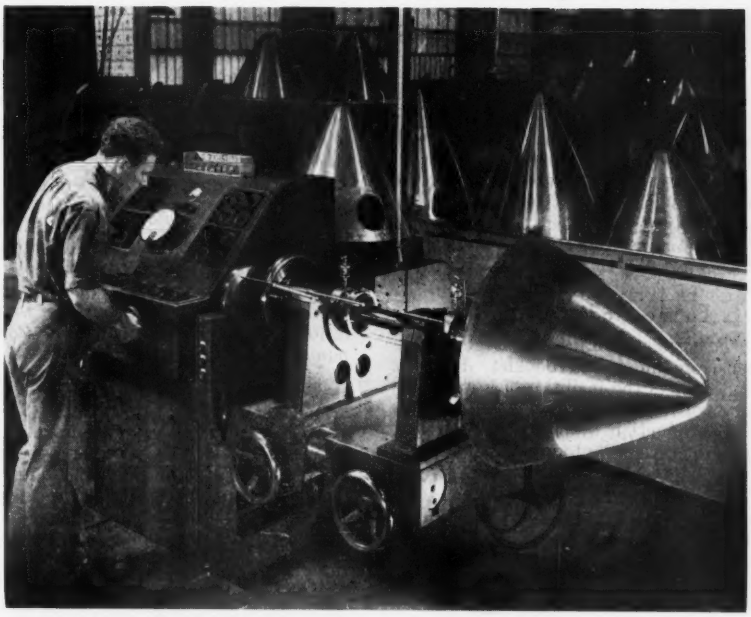
Spares for Pre-War Pacemakers. This is an account of Lockeed Aircraft Corporation's program for bringing the production of spare parts back to an adequate schedule by the time the Government begins to return airplanes to private owners. Factory area, facilities, and personnel now devoted to the project are noted, and a report is made of the number of orders being filled currently. Some data are given also on manufacturing procedures employed in the production of these spares. *Lockheed Log*, October, 1944.

List of House Organs

Printers' Ink Directory of House Organs lists 5,100 house organs of American and Canadian companies. About 270 of the house organs are published by manufacturers of aircraft, engines, and accessories and by air lines. The house organs are listed in four sections: an alphabetical register of titles; sponsors, alphabetically arranged; sponsors, geographically arranged; and house organs temporarily suspended. Symbols indicate whether they are internal publications for circulation only among employees; external publications for distribution to customers, dealers, stockholders, or the general public; or a combination of internal and external. As the geographic section includes street addresses, it serves also as an industrial directory. *Printers' Ink Publishing Company, Inc.*, New York, $2.50.

Aircraft Development

De-Havilland Aircraft. A booklet illustrates and briefly describes some of the past and present aircraft built by the de Havilland organization, from the D.H. 1 of 1915 to the Mosquito. A chart shows the development of the Mosquito and its bomb-carrying capacity from 1940 to 1944. *De Havilland Aircraft of Canada, Limited.*



A propeller spinner is checked for perfect dynamic balance at the Propeller Division of Curtiss-Wright Corporation.

Air-Cargo Stowage System

Air Cargo Ground Handling and Stowage. Referring to both ground-handling and stowage phases, a system of material handling for air cargo is described. This system is based upon the use of electric industrial trucks and single-face pallets and containers. It incorporates the employment of "fork truck" trailers with hand-lift trucks to handle the unit loads or containers inside the plane. Strapping and storing the cargo are accomplished by means of clamps. Diagrams and photographs illustrate the equipment required. *The Yale & Towne Manufacturing Company*, Philadelphia.

Bearing Maintenance

Anti-Friction Bearing Maintenance. In this manual instructions are given for the general handling of bearings, their maintenance, and their conservation. Repairmen in shops and field organizations are advised how new bearings can be protected from damage and how usable bearings can be removed from worn equipment, properly cleaned, and installed in the same or other equipment for further use. Various types of bearings and their parts are identified. *Engineering Committees of Anti-Friction Bearing Manufacturers Association, Inc.*, New York.

Air Express for the Future

Vision Unlimited. The history and progress of air express are reviewed in a 14-page brochure. Present-day methods are compared with those of pioneer air-express flights. The growth in both domestic and international air-express routes, the increase in volume of air-express shipments, the reductions in rates, the increase in the variety of products that are now shipped by air, and the increase in airplane cargo capacities are depicted by charts and illustrations. All of these are used as a basis for predicting the future expansion of air-express services. *Air Express Division of Railway Express Agency, Inc.*

Postwar Airplane

The Next Airplane. C. C. Furnas. The Curtiss-Wright Airplane Division's Director of Research gives his ideas on what will be required of postwar airplanes and how these specifications will be obtained. He also indicates the benefits that will be enjoyed as a result of new developments in aircraft. Mechanical factors that will contribute to safety, reliability, low cost, speed, and comfort are discussed. It is the writer's prediction that the four things that will lead to the greatest evolutions in airplane-development are radar, gas turbines, jet propulsion, and the helicopter. *Curtiss Fly-Leaf*, September-October, 1944.

Freighting by Air

Here Comes American Airlines Air-freight! Describing American Airlines' air-freight services, this booklet tells how to ship by this method, what can be shipped, how much it will cost, where it will go, and how fast it will go. It shows actual examples of air freight in action and discusses the facilities that are available for adapting this medium to a particular shipper's needs. As compared to Air Express with its immediate pickup and delivery, air freight is interpreted as a "deferred service." By this means shipments are spread over available capacity, utilizing hundreds of thousands of ton-miles of transportation which otherwise would be un-

avoidably wasted. *American Airlines, Inc.*

Folder on Plastics

Celanese Plastics. A folder describes applications of Celanese plastics to civilian goods. A table gives properties and typical uses for various types and forms of cellulose plastics, including aeronautical applications. *Celanese Celluloid Corporation, Division of Celanese Corporation of America.*

Engine Production Facilities

Tomorrow and Liberty, a large and extensively illustrated booklet, describes and depicts the facilities of a manufacturer of tools and equipment for industrial production widely used in aircraft manufacture. Photographs of the company's plant equipment are supplemented by brief descriptions and sketches of the various departments. A list is given of the company's products and the uses for which they are intended. *Liberty Motors and Engineering Corporation,* Baltimore.

Air Line's War Role

Here, There, Anywhere. In a 30-page illustrated booklet the story is told of American Airlines' war assignments up to October, 1944. Rendering an account of how a peacetime air line was speedily transformed into a round-the-world transport service, the booklet includes information about the company's operations under the direction of the Air Transport Command. There are also reports on its activities in helping to train A.A.F. personnel, its research and laboratory work, and its participation in developments that have advanced America's military aviation equipment and techniques. *American Airlines, Inc.*

Assembly-Line Stations

That's How Bombers Are Born. Functions of each of the 15 stations in the assembly line of Bell Aircraft's Marietta bomber plant are surveyed briefly. Various operations are illustrated by photographs. *The Bellringer,* November, 1944.

Bendix Radio Equipment Data

Several publications have been issued regarding newly designed Bendix radio units. These include bulletin numbers SE-101, SE-105, and SE-106 with respective reference to series MP34 Power Supplies for 110- or 220-volt a.c. operation of TA-2 Series Transmitters; 75 Megacycle Marker Receiver, and MT-93 Expressor Amplifier. There is also a booklet giving a preliminary description of TG-14 series of ground-station equipment. The description in the booklet refers to MP36A three-phase rectifier, MT90A High-Frequency RF Unit; MT91A Low-Frequency RF Unit; MT92A Modulator Unit; Remote-Control Console; Dialing Circuits; Keying Unit. *Bendix Radio Division of Bendix Aviation Corporation.*

Air-Cargo Containers

Air Cargoes is the title of 43-page book explaining the advantages of the corrugated box and its place in air-cargo work. Factors that must be considered in determining the specifications of containers for air shipment are listed. Information is given about the cost of fiber containers, their resistance to compression and impact, and their shock-absorbing and insulation characteristics. Sections are devoted to the cost of air freight, what can be shipped by air, how to ship by air, and container regulations for air cargo. *Robert Gair Company, Inc.*

Heavy-Duty Switches

Micro Switch. A catalog, designated as *No. 71,* describes heavy-duty types of Micro switches and auxiliary devices for aircraft and certain other services. Sections of the catalog are devoted to switches built to conform to Army-Navy aeronautical specifications, basic Micro switches, peanut micro switches, and switch technical data. *Micro Switch Division of First Industrial Corporation,* Freeport, Ill.

Plug Buttons

Plug Buttons. Section 8 of an engineering data catalog contains the specifications of plug buttons used to cover drilled holes in various materials, including metal, plastics, fiber, and cardboard. When the plug button is snapped into the hole to be covered, the spring action of the prongs holds the plug button securely in place. Standard and special types are listed. *United-Carr Fastener Corporation,* Cambridge, Mass.

Transoceanic Air Travel Conditions

Is it Dangerous? Fred B. Barton. A description of transoceanic air travel as the passenger finds it today, with advice on how to prepare for such travel. The prospective passenger is told what to carry with him, what he will eat, how he will sleep, etc. In comparison with other forms of travel, he is informed that, in the opinion of the writer, there is no greater danger in traveling by air than by any other method of transportation. *Plane Talk,* November, 1944.

Lock Washers

A bulletin illustrates and describes typical applications of Shakeproof lock washers. Information is given about the various types of lock washers produced. *Shakeproof, Inc.,* Chicago.

Communications in War and Peace

Circuits for Victory is a 40-page book depicting the role of communications weapons in modern warfare. Using the pictorial technique, it reveals how progressive improvement in designs and methods advanced the telephone and radio from a neighborhood curiosity to a worldwide network of voice channels and how those communication devices are helping on all battle fronts. Intended mainly for distribution among company employees, the book is non-technical in its approach. *Western Electric Company,* New York.

Control Surface Hydraulic Boosters

Booster System. C. L. (Kelly) Johnson. Explaining the operating principles of control boosters in their application to aircraft, the writer tells how boosters were developed for the Constellation which not only helped to solve flight-safety problems but also furthered the science of airplane design. Ten aerodynamic advantages obtained are listed, and four limiting factors of boosters are noted. However, it is pointed out that all of the disadvantages are of a mechanical nature, subject to correction through good design. *Lockheed Log,* October, 1944.

Plastic Coaters

Bulletin YM-800 describes the operation and features of a line of plastic coaters. These machines are designed to melt properly ethylcellulose compound and other plastic coatings used for protecting parts and tools being stored or shipped overseas. The equipment is also employed for melting low-temperature plastics used for permanent coatings. *Youngstown Miller Company,* Sandusky, Ohio.

Welding Electrodes

Resistance Welding Electrodes and Alloys. A catalog on resistance welding electrodes and alloys lists the company's line of standard spot-welding electrodes and water-cooled holders. A list of welding alloys, their various applications, and physical properties is included. A section of the catalog contains "do's" and "don't's" for resistance welders. *P. R. Mallory & Company, Inc.,* Indianapolis.

Multiple Spindle Drill Heads

A 16-page illustrated catalog describes Thriftmaster multiple spindle drill heads and their accessory equipment. Included are descriptions of a new spindle designed to permit a depth adjustment of 0.0015-in. increments, and a line of adjustable drill heads consisting of two or more spindles with a positive locking device. An account is given of multiple machining and drilling operations for reducing production costs. *Thriftmaster Products Division of Zimmer-Thompson Corporation,* New York.

Metamorphosis of a Wing Part

From Raw Stock to Flight Line. A series of 16 photographs depicts the nature and sequence of the manufacturing operations through which a "B" skin of the Bell Kingcobra passes. The component is one of four sections comprising the leading edge of the wing. *The Bellringer,* November, 1944.

Internal Grooving Tool

A pamphlet describes a tool designed to cut internal grooves in cylindric

bores and housings to close tolerances on a quantity-production basis. A chart also has been issued showing which of the Waldes Truarc retaining rings, internal and external, are applicable to metric and inch-type ball bearings. *Waldes Koh-I-Noor, Inc.*, New York.

Production and Maintenance Suggestions

The Jahco News, October, 1944. (1) New-type fixture for Rockwell-testing of housings removes guesswork in checking, increases production, eliminates excessive handling, holds housing parallel, and relieves fatigue; (2) use of three baskets for operations of impregnating and draining armatures results in safer setup, easier handling, increased production, even and faster drainage of varnish, easier balancing, and an easier and faster spinning operation; (3) a new fixture for the chuck top plate of the Heald Rotary or Blanchard grinders enables the operator to grind more than one part at a time, increases production, and reduces the amount of manual effort required; (4) cold-treatment of cutting tools and gauges while they are being hardened increases durability of the tools.

The Consolidated Vultee Volunteer, October 27, 1944. (1) A gauge on the Minster press eliminates the guesswork in cutting material and reduces the amount of salvage; (2) material-support attachment for the punch press.

North Ameri-Kansan, October 27, 1944. Improved jaws on the Hufford stretcher machine permit a more complete bend of sheet metal and result in more accurate shaping of angles and channels.

The Curtiss-Wrighter, October 13, 1944. (1) Use of stagger-tooth cutters eliminates sawing operation on terminal brace struts; (2) a trim template is used for locating the trim line on rib flanges; (3) addition of flexible spring and hand grip improves Riv-Nut squeeze; (4) a stringer clamp is employed for positioning stringers in bulkhead cutouts; (5) placing of a disc, placed on a rotary file and larger than the end of the file, forms a flange that prevents the file from damaging the parts being worked on; (6) tool for tightening straps on aircraft gasoline tanks, as well as the straps on landing gear struts; (7) use of double-tip torches on the second heating of a large and heavy tube.

The Kinner Log, November 5, 1944. (1) Use of a compound angle block of 15° by 5° to grind the flange-radiuses form tool; (2) drain to be used on lapping machine; (3) redesigned block simplifies surface-grinding setup procedures; (4) lubrication of shrink diameter and threads with castor oil; (5) improved method of fastening engine into test stand; (6) invention of chip catcher for thread machine; (7) plan for retooling handle of wheel dresser.

The Menasco Flying M, November 10, 1944. An auxiliary anode for plating between the lugs of the airplane's nose cylinder.

The Curtiss Wright-er, November 3, 1944. (1) Assembly of the quadrant to the pedestal as a subassembly permits the two parts to be installed later as one unit; (2) improvements to the drill-press handles on the 20 per cent spar-drill jig; (3) template for locating pilot holes on the plate of the 20 per cent spar; (4) bar for spreading the nose section ribs when splicing to center panel assembly; (5) improved method of fitting windows in center aft side assembly; (6) improved design for boring bars used on certain airplane parts.

North American Aviation, Inc., Take-Off, November 17, 1944. Improved punch design for a small table-mounted punch press.

Douglas Airview, November, 1944. (1) New type shoe with a replaceable center for monorail overhead crane can be removed with aid of two setscrews and permits replacing of part without delaying the crane; (2) use of 8 shutoff cocks and 8 hose lines branching from one common line attached to the spar pump instead of the old hand-gun method for bleeding fuel and oil from an aircraft's light transmitters simplifies operation and saves a large number of man-hours; (3) enlargement of the working platform for a stretch die to hold an ample supply of raw stock, and the use of a basket in which to place completed skins, eliminates walking and saves time; (4) drill guide and jig, for drilling holes in hat sections to longerons, locates and drills holes at intersection of hat section and longeron, saving time and tools; (5) new-style pins for use in piercing punches for pierce blank template result in more support for the backing plates, keep punches from falling out, and necessitate less rework and replacement; (6) rounding and smoothing sharp edges on drill chucks by sanding saves waste of material caused by the striking of the chuck during drilling operations; (7) drill jig and template compression for camera-door plate assembly makes subassembly of parts formerly installed in four positions on the line, enables the drilling of five doublers and five skins at one time, and saves time; (8) special spreader bar, operating on principle similar to that of the turnbuckle, develops desired contour tolerances with minimum effort, eliminates old method of driving wooden wedges at various points, and saves man-hours; (9) clamp dimpler for dimpling splice plate to longerons enables both station and splice plate to be dimpled at same time, performs operation more accurately, and saves man-hours; (10) employment of an automatic air cylinder on the hydraulic table eliminates physical labor in the operation of the hydraulic jig, results in the obtaining of 1 ton more pressure, and enables the operation to be performed simply and easily through control of air valves; (11) tool to form and solder hydraulic-fluid strainer reduces the time for making and soldering the part by 42 minutes and eliminates rejections; (12) jig for installing rear spar pulley bracket makes installation more accurate.

The Consolidated Vultee Eagle, November 10, 1944. Idea for a permanent air line to a compression rivet machine.

North Ameri-Kansan, November 24, 1944. (1) Timer on the relays in spot-weld machines prevents machines from running if there is any malfunctioning of the electrical mechanism while operating; (2) device for drawing and bucking rivets in tank headers; (3) threaded locking ring and exhaust deflector for Cleco riveter.

McDonnell Bulletin, November 24, 1944. The use of a gang perforator to punch holes in the flange of the rib and channel in one phase of elevator assembly, together with a jig designed to locate the channel in the rib. This, with the installation of a squeeze riveter on the work bench, permits the entire operation to be performed by one operator with a minimum of moving.

Grumman Plane News, November 23, 1944. Special tool burrs both sides of a hole in one operation.

North American Aviation, Inc., Take-Off, November 24, 1944. Method of sandblasting phenolic fiber surfaces before painting to replace hand sanding.

Consolidated Vultee Convair News, November 10, 1944. Device for locating holes in drill plates and jigs.

North Ameri-Kansan, December 1, 1944. (1) A set of indexing plates speeds up the grinding operations on carbide cutters and reamers; (2) a sliding-scale attachment for a swaging machine; (3) combining the operation of countersinking with the placing of rivets in the countersunk holes enables both operations to be performed simultaneously by one operator.

The B. F. Goodrich Circle-News, October 28, 1944. Easier method of cementing cord used in the manufacture of fan belts.

Douglas Long Beach Airview News, October 31, 1944. (1) Tube-bending machine; (2) special hold-down clamp for attaching angles on wing-spar jigs.

Production Executive

Meet "Woody" Woodson. Keith Monroe. Some brief biographic notes on Omer L. Woodson, new Vice-President and General Manager of the Ryan Aeronautical Company. In tracing 27 years of affiliations with the aviation industry, highlights of Mr. Woodson's career are mentioned in connection with his work with the A.E.F. of the first World War, the Service Aviation Company, The Woodson Engineering Company, the Northrop Division of Douglas Aircraft Company, Inc., the Curtiss-Wright Corporation, and Bell Aircraft Corporation. *Ryan Flying Reporter*, November 11, 1944.

Girl in bomber fuselage is tightening one of the hundreds of wire harness bands used on each Boeing B-29 Superfortress. Bands are supplied by United-Carr Fastener Corp. Each band is lined with cellular rubber, produced by Sponge Rubber Products Co., to cushion, insulate and prevent chafing. Parts are small – but they do a big job in protecting wiring against vibration of four 2200 h.p. motors and the recoil of Superfortress guns.

AVAILABLE NOW

Specially Compounded for the Aviation Industry

We can accept your order now for sheet sponge rubber specially compounded for the aviation industry. Light weight; resists gasoline, oil, corrosive vapors, and abrasion. Supplied in continuous sheets of any desired thickness and resiliency. Use it to insulate, block sound transmission, cushion floors, seal out moisture, dampen vibration. You can also have die cut pieces, molded parts, continuous strips or cords, compounded to meet your special requirements. Tell us your problem; our technical staff can help you solve it quickly and economically.

THE RUBBER COLLAR THAT TOOK THE 'RUB' OUT OF WIRE HARNESS

. . . A lesson in post-war progress from a Boeing Superfortress

The tiny strips of cellular rubber that cushion the hangers for wires in the B-29 Superfortress cost just a few pennies. But what a man-size job they do! They soak up vibration . . . prevent chafing . . . keep wires in condition to "keep 'em flying"!

Wherever there is a danger of vibration – in an automobile, an airplane, a railroad train, a machine tool, a home appliance – *any* motor-driven piece of equipment – similar applications of cellular rubber can lengthen the life of equipment; help assure trouble-free operation.

Two Basic Types Available

Our organization, with 21 years' experience compounding sponge rubber (Spongex*) also produces another basic type of *cellular rubber* – Cell-tite*. In Spongex, the most familiar type of this material, the cells inter-connect. In Cell-tite the cells are individual, separate, filled with inert gases.

Consult us *now* if you need any variety of cellular rubber. We are able and ready to help you solve any problem of sealing, cushioning, vibration dampening, sound deadening, insulating, and have ample production facilities to meet your present and post-war needs.

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Sponge Rubber Products Co.

109 Derby Place, Shelton, Conn. • Plants in Derby and Shelton, Conn.

Sales Offices: NEW YORK • CHICAGO • WASHINGTON • DETROIT

World's Largest Manufacturer of Cellular Rubber Products

From the Industry

Anvil Blocks for Measuring-Instrument Anvils

It is stated that comparator anvils and the anvils of similar measuring equipment can be protected against wear through use of new antiwear anvil blocks.

According to the manufacturer, the anvil block can be wrung to any flat anvil (serrated or plain) and it will adhere firmly. Because the work rests on the anvil block instead of the instrument anvil, the block takes the wear, keeping the instrument anvil free from wear indefinitely.

It is also claimed that anvil blocks are easier and less costly to replace than worn anvils.

The manufacturer further states that the new anvil blocks are lapped flat and parallel on all four sides to within a few millionths of an inch and are made of hardened and seasoned gage-block steel to assure accurate readings.

Standard size anvil blocks are $^1/_2$ in. wide, $^1/_2$ in. high, and $1^3/_8$ in. long and are available from stock. Other sizes can be furnished to meet special requirements. Acme Scientific Division of Acme Industrial Company, Chicago.

Aluminum Drums for Transporting Gasoline by Air

Aviation gasoline is being flown to the China front in a new type of lightweight gasoline drum. The container is an aluminum drum weighing only 21 lbs., compared with the 52-lb. weight of the old-type container. Other advantages are that aluminum does not require paint, is rustproof, and can be used many times.

Sample test drums, made by hand, were given every possible test, including pressure, rolling, bursting, and degassing. These were conducted by the equipment laboratory of the Army Air Forces at Wright Field and by engineers of the Aluminum Cooking Utensil Company. Some of the models were then flown to India and placed in actual service.

An allotment of the drums, accepted by the Army following exhaustive research and tests, has been flown by the Air Transport Command directly to India, in order to increase the supply of gasoline needed by the 14th and 20th Air Forces fighting the Japanese in Asia. Aluminum Company of America.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

Insert Chart of AN Electric Connectors

Knowing the required number and sizes of wires, an engineer can make proper selection quickly by using a new chart of molded AN insert arrangements. The inserts are plainly grouped by total number of contacts in vertical columns and in numerical order, reading from top to bottom and left to right.

All standard inserts from one to 100 contacts are shown full-size. All socket or pin arrangements are clearly indicated, together with wire sizes. Coaxial cable connections and grounded or shorted inserts are included. Mechanical spacing of contacts and alternative positioning of the inserts with new position numbers are given in each case. Exploded pictures of pin and socket inserts add considerably to the usefulness of the chart. The chart is 50 by 38 in., printed in blue and black on heavy yellow stock.

A complete chart of AN and Amphenol 97 shell types and styles is supplied with each insert chart. This includes the special-purpose shell type such as pressure-tight, moisture-seal, explosion-proof, lightproof and other plugs and receptacles. Another chart is included to aid in clarifying the numbers used in specifying connectors. American Phenolic Corporation, Chicago.

Features of a Simplified Helicopter Design

Features of the Bendix helicopter are described as simplicity of operation and control; automatic autorotation designed to make the aircraft safe at any altitude so that it can normally be flown with safety 100 to 200 ft. above the ground; and the elimination of noise and vibration by elimination of cyclical pitch change. Counterrotating rotors eliminate the need for an antitorque propeller.

Embodied in the 300-hp. helicopter sedan, which will be the builder's first postwar model, are many features of operation and control that are stated to be simpler than those of an automobile. An ascension lever is operated by the left hand, which moves the lever upward to ascend, downward to descend, and in an intermediary position to produce hovering at any height desired. The pilot holds in his right hand the control lever by which he controls the direction of flight and pitch and roll, thereby producing stabilization through three-axis control.

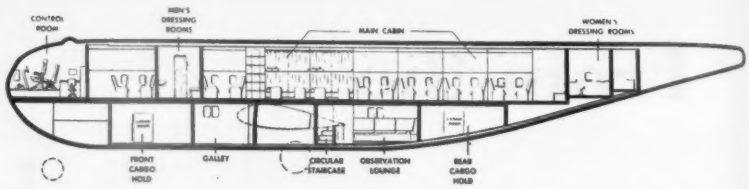
The manufacturer states that, in addition to the projected use of the helicopter for personal transportation, it will prove useful for freight transportation, being capable of point-to-point or door-to-door flight. With slight body changes the sedan may be converted into a freight carrier with an approximate capacity of three-quarters of a ton. This freight model is also capable of other uses, such as insecticide spraying, forest-fire patrol, rescue work at sea, etc.

The Bendix helicopter four-passenger sedan is designed to have an approximate top speed of 140 m.p.h., a cruising speed of 120 m.p.h., and a minimum rate of climb of 600 ft. per min. The price of the machine is expected to be about 25 per cent higher than the larger types of motor cars, based on quantity production. Bendix Helicopter, Inc., New York.

Midget-Type Relay

The Corosealed relay is a midget-type relay especially designed for communication, electronics, and aircraft applications. These relays are hermetically sealed in a metal shell to assure correct performance under severe conditions of temperature, humidity, pressure, dust, corrosion, and fungi. Units are normally sealed with content of prefiltered dry air, but can be supplied with inert-gas or pressurized content when desired.

Coil windings can be supplied for voltage ranges from 1.5 to 70 volts d.c. and are wound to an exact number of turns. Every unit is subjected to a 1,000-volt breakdown test. The inorganic-base plastic insulation is intended to minimize high-frequency loss and to assure permanent dielectric and mechanical strength. Contacts are arranged for a capacity of 2 amp. at 100 watts. A magnetic circuit permits satisfactory operation even with coil voltage fluctuations as great as 25 per



The 3-view silhouette (*left*) and a projected cabin arrangement (*above*) of the Boeing Model 377 Stratocruiser.

cent. Betts & Betts Corporation, New York.

Boeing 377 Stratocruiser Specifications

The Boeing 377 Stratocruiser is a four-engined, low-wing, two-deck pressurized-cabin passenger or cargo transport. The following specifications have been released: wing spread, 141 ft. 3 in.; length, 110 ft. 4 in.; height, 33 ft. 3 in.; weight empty, 70,000 lbs.; landing weight, 105,000 lbs.; and gross weight, 130,000 lbs.

The airplane is powered by four engines of 3,500 hp. each at take-off, giving a maximum speed of 400 m.p.h. and a cruising speed of 340 m.p.h. Operating range is 3,500 miles and the operating ceiling is 30,000 ft.

The special day-travel version of the Stratocruiser will have a maximum capacity of 100 passengers; as a sleeper it will provide 36 berths or 72 passenger seats in the main cabin and 14 seats in the lounge. The combined passenger and cargo version will accommodate 86 passengers and will also have a cargo capacity of 750 cu.ft. In the all-cargo version the craft will have 3,000 cu.ft. of usable space and pay-load capacity of 35,000 lbs. The main passenger cabin is 60 ft. in length and is completely supercharged except for the tail storage area. When the plane is flying at altitudes of up to 30,000 ft., atmospheric conditions in the cabin are maintained at the equivalent of the 8,000-ft. altitude.

The propellers are of four-blade design, each being 16 ft. 7 in. in diameter. The tricycle landing gear has dual wheels. The wing design is the Boeing "117," the same as the wing of the B-29, and the tail surfaces are also the same as those of the Superfortress. The maximum cross section of the fuselage is 15 ft. 9 1/2 in. high and 11 ft. wide.

For transcontinental flights the crew will consist of three members in the operating group and two stewards. For transoceanic flights there are to be four members in the operating crew and three in the steward's department. It is estimated that the direct operating cost of the passenger version will be the equivalent of 1 cent per passenger-mile; of the all-cargo version it will be 5 cents per ton-mile. Boeing Aircraft Company.

Carbide Gage Fingers

Carbide gage fingers are used in grinding the outside diameter of aircraft-engine cylinder sleeves to extremely close tolerances. The gage fingers, made of Carboloy cemented carbide where they make contact with the rotating work, are so set that when the gage reads "0" they automatically shut off the machine feed. This saves an appreciable amount of time on long production runs.

Since no lubricant can be used on these gage fingers, ordinary steel tools would wear away so rapidly that the operator would be required continually to reset his gage to maintain accuracy. The Carboloy fingers are reported to stand up under these conditions, making this type of gaging fixture practical with a resultant increase in production. Carboloy Company, Inc., Detroit.

Cam and Helicoid Movement Principle for Aviation Instruments

Development of a new principle in the manufacture of low-cost, accurate aviation instruments is expected to make flying in postwar family-type planes safer.

The new mechanism is stated to be capable of measuring air speed, altitude, gasoline consumption, and other necessary factors with accuracy. It features a cam and helicoid movement instead of the conventional "toothed" gear movement of other low-cost instruments. Certified Gauge and Instrument Company, Long Island City, N.Y.

Corrosion-Resistant, Precipitation-Hardening Alloy

A precipitation-hardening alloy, characterized by uniformity in response to heat-treatment, has a nominal chemical analysis of 60 per cent copper, 20 per cent nickel, and 20 per cent manganese and is designated as Chace No. 720 manganese alloy. Although the alloy is more than half copper, it has a silvery color and presents an attractive surface when polished. It is corrosion resistant; in this respect it does not differ greatly from the cupronickels.

The alloy is a soft, ductile metal that can be hot- or cold-formed into intricate shapes and then hardened by a comparatively low-temperature aging treatment. It is reported that a hardness of 400 Vickers can be readily obtained by aging either soft or cold-worked material. The physical properties corresponding to this hardness are: tensile strength, 200,000 lbs. per sq.in.; yield stress for 0.1 per cent offset, 170,000 lbs. per sq.in; and a proportional limit of 120,000 lbs. per sq.in. Freedom from "drift" and high fatigue strength indicate that the alloy is useful as a spring material.

Hardening to any degree is produced by varying the time at the aging temperature. The aging temperature is always the same, 750°F., but is not critical since it may be varied 100°F. without affecting the resultant hardness. Hardened parts may also be drawn to any lower hardness by heating for a few minutes at a temperature selected between 850° and 1,100°F. After heating to the latter temperature the material will be fully annealed. To reharden material softened in this manner it is only necessary to repeat the aging treatment. The elimination of a solution treatment as a prerequisite to aging simplifies the heat-treating procedure and accounts for much of the uniformity in physical properties claimed for the alloy.

The deep-drawing characteristics and the low work-hardening rate of the alloy indicate that it may be used to advantage for corrugated diaphragms, Bourdon tubing, and temperature- or pressure-responsive bellows. The ductility of the metal when either hot or cold makes possible the production of corrosion-resistant forgings or upset parts that may be finish-machined and then hardened by heating to 750°F.

The material is available in all the forms in which stainless steel is usually supplied. Cold-rolled strip is produced to close thickness tolerances for precision spring applications. Wire in all sizes is produced from this alloy by the Driver-Harris Company, Harrison, N.J. Bulletin A-744 gives details about the physical properties, heat treatment, and application of the alloy. W. M. Chace Company, Detroit.

Snap Fairlead for Aircraft

A new type of fairlead for airplanes is made of plastic and rubber. This is snapped into panel openings instead of being bolted as in the conventional manner. Known as the Cycle-Weld snap lead, this new device, which weighs 5 grams, can be installed in 10 to 30 sec., compared to 2 to 10 min. for the present

26.2-gram type of fairlead made of bolted phenolic laminated plates.

Two small rubber strips, which serve the dual purpose of holding two companion plastic pieces together and providing an elastic grip as the lead is snapped into panel slots, are held in place at four opposite points by "magic glue," a process of cement-binding called Cycle-Weld. Pressed firmly with the thumb, the new type of lead is snapped into special panel openings after the control cable has been inserted in the lead itself through holes formed on one side of the lead while the rubber strips are relaxed. Two tiny ridges—at the top and bottom of the snap lead—grip the edges of the panel slots. Tension set up by the rubber strips sets and holds the leads into place. When pressed into position, the two plastic pieces form a single unit containing a hole of either $^3/_{16}$- or $^1/_4$-in. diameter. The flexible metal leads, or cables, pass through this from various controls of the plane to the pilots' cabin.

In addition to the saving in weight and installation costs, the snap lead is credited with having proved in tests that it will withstand more wear than the present types of leads. A belled surface at the mouth of each lead hole minimizes the possibility of rubbing and resulting frictional wear as the cables move backward and forward. One person, without a tool of any kind, can snap the lead into place with one hand.

When snapped into position the Cycle-Weld fairlead is $1^1/_{16}$ in. long, $^7/_8$ in. wide, and $^1/_2$ in. thick. The rubber strips holding the halves together are $^3/_8$ in. wide, less than $^1/_8$ in. thick, and approximately $^2/_8$ in. long. Chrysler Corporation.

"Glass-Lined" Insulation for High-Altitude Aircraft

The C-46 military transport, forerunner of the Curtiss CW-20 Commando 36-passenger postwar model air liner, is insulated against low temperatures by a fiber-like glass insulation lining that is reported to make it possible to hold the interior at a comfortable temperature when the outside temperature is as low as −40°F. The CW-20 Commando commercial air-liner model is to be similarly insulated.

The plane's new insulation is in the form of minute glass fibers, 0.0002 in. in diameter, fabricated into a soft blanket $^1/_2$ in. thick and installed in the airplane by means of aluminum-finished trim cloth and snap fasteners.

The insulation is reported to afford a saving in weight of more than 200 lbs. per airplane of the Commando size by comparison with other materials. The entire glass fiber installation for the Commando weighs only 185 lbs.

The glass fiber blanket is a development of the Owens-Corning Fiberglas Corporation. It weighs 1 oz. per sq.ft. in the $^1/_2$-in. thickness. Besides its lightness, the glass insulating material is easily fabricated, an aid in fitting it around electrical outlets, control boxes, corners, windows, air ducts, etc. It is noninflammable, has high sound-absorbing qualities, and, being glass, absorbs moisture to only a slight degree. The material is chemically inert and does not cause corrosion of metal; it is inorganic, vermin-proof, and will not support any kind of fungus growth. Sound-deadening tests of the $^1/_2$-in. Fiberglas and its trim cloth showed an average attenuation in decibels of 63.0. In the Commando an extra soundproofing of 1-in. thick Fiberglas and a specially quilted lightweight porous trim cloth have been installed in the pilot's compartment and space adjacent to the engines.

The entire insulating assembly can be rolled into compact packages and transported to Air Forces modification centers or to distant air bases. No tools are required for its installation. Curtiss-Wright Corporation.

A view of the pilot's compartment of the Curtiss C-46 Commando showing the inch-thick Fiberglas insulation with diamond-quilted trim cloth.

Recessed Nose Design for Curtiss Commando

The Commando's new recessed windshield design was brought about to improve pilot vision and general cockpit operation. Recessing of the windshield is the principal change in the contour of the airplane. The flat glass type eliminates distortion, making for better windshield-wiper action, as well as increasing markedly the range of the pilots' vision. Deeper side windows have also been incorporated into the new design.

The new windshield consists of two double panes of safety glass separated by an air space, planned to meet the Civil Aeronautics Administration's recommendations for "bird proofing." A clear-vision panel, which may be opened in flight, has been provided to make it possible to obtain a forward view under extreme icing conditions that cannot be taken care of by the thermal deicing system. This panel also makes it possible to clean ice or other accumulations from the front of the windshield manually while in flight. The pilots' seats in the new design have been moved forward to within 18 in. of the windshield; this in itself gives an appreciable increase in the range of vision.

Dual sets of flight instruments and controls have been installated in the new Commando and the automatic pilot and engine instruments have been regrouped in the center of the upper main panel within easy reach from either the pilot's or copilot's seat. All flight controls, gages, and instruments in the dual installation are identical and interchangeable. Close consideration of servicing and maintenance requirements has been given by the designing engineers to assure ease and speed in operations. Curtiss-Wright Corporation, Airplane Division.

Adhesive for Engine-Compartment Insulation

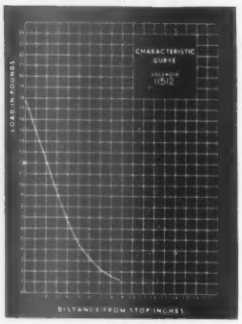
No. 1873 Improved Cork Dolfinite is a waterproof, anticorrosive oil-base material of semipaste consistency, used for cementing and attaching insulation in engine compartments.

The makers state that the product has a high flash point, an indirect burning point up to 700°F., and will neither throw off any explosive fumes at temperatures up to 1,000°F. nor burn in its wet state. The Dolphin Paint & Varnish Company, Toledo, Ohio.

Magnesium Wings on Navy Trainers

Airplane wings fabricated entirely of magnesium have been in flight for more than a year on Navy training planes. Work has been in progress on

Faster, more efficient operation with CANNON D.C. SOLENOIDS



Response characteristic charts like the above (test at 28 volts) together with wiring diagrams are found in Solenoid Bulletin.

With Cannon Electric D.C. Solenoids you get automatic, trigger-action. Solenoid pull is positive. Cannon Solenoids may be operated without damage to a maximum temperature or approximately 150 degrees C.

A wide selection of Cannon Solenoids are built for various combinations of voltages, pull,armature travel, duty cycle, etc. to suit design requirements. Nominal voltages are 12 and 24; others by special order. Eight types have "holding" features.

As a reliable means of controlling or operating various devices, they are used for retarding magnetos in starting engines, operating hydraulic valves and mechanical clutches, firing machine guns, arming and releasing bombs, dropping auxiliary fuel tanks, locking retracting gears, film-winding mechanisms for shutter control on special cameras. These are only a few of the possible applicaions. *Let us know your needs.*

A copy of the Cannon Electric Solenoid Bulletin —34 pages of diagrams, data and photos of the complete line will be sent free for the asking. Address Department A-105, Cannon Electric Development Company, 3209 Humboldt Street, Los Angeles 31, California.

Also manufacturers of Electrical Connectors

CANNON ELECTRIC

Cannon Electric Development Company
3209 Humboldt St., Los Angeles 31, Calif.

Canadian Factory and Engineering Office:
Cannon Electric Company, Limited, Toronto

REPRESENTATIVES IN PRINCIPAL CITIES — CONSULT YOUR LOCAL TELEPHONE BOOK

the magnesium-wing project, in cooperation with the Navy Department and Bureau of Aeronautics, since 1940. The original set of wings was designed for the Navy's SNJ-2 advanced trainer built by North American Aviation, Inc.

After static tests and certain minor changes in design in 1942, 30 sets of the wings were ordered. It is stated that these wings have now been in regular service at naval air training stations since early in 1943 and have proved satisfactory. In addition to the aluminum wing, standard on the SNJ models, wings of low-carbon steel, stainless steel, plywood, and other materials have also been tested. The magnesium wing is reported to be lighter than the standard aluminum wing. The Dow Chemical Company.

Special Motor-Driven Actuators

An electric actuating unit for an oil-cooler door, specially built to meet exacting installation conditions and to closest weight limits, was designed to fit an existing air-frame section where only minor structural changes were permitted.

A 1/8-hp. thermally protected motor equipped with magnetic clutch and brake is the principal part of this compact and self-contained motor-driven gear-reduction unit, used in a 28-volt system. Compound planetary gear reduction of 450 to 1 is provided, with an additional worm-and-sector reduction of 30 to 1. Maximum torque on the drive shaft is 6,000 in.lbs.

Some of the uses suggested for such specially designed electric drives are for speed increasers, splash-proof inverters, d.c. submersible pump motors, hand-driven alternators, hub motors, and actuators for opening and closing cowl flaps, driving gun turrets, actuating wing flaps and dive brakes, and retracting and lowering landing gear.

Standard motors are available as such or they may be equipped with clutch and brake, cooling fans, gear trains, limiting devices and controls, or any necessary combination, as conditions indicate. Electrical Engineering and Manufacturing Corporation, Los Angeles.

Postwar Family Airplane

The Fairchild M-84 is a new personal airplane being developed for sale to the public when production materials are released by the WPB. The design is of the low-wing type and will have space for four persons, with the possibility of providing for five on short-range operations.

Designed as a family airplane, the craft is planned to be easy to fly and to have a low landing speed so that beginners and light-plane pilots will be able to handle it safely. Easy entrance and exit will be provided, and it will have broad vision in all directions. It is being developed directly from the manufacturer's experience in designing and producing the PT-19 Cornell trainer. Its safety features and general

appearance are similar to those of the P-19.

In accordance with War Labor Board policies, only a small percentage of the builder's personnel can now be placed on postwar projects and production of the M-84; other future models, now on the drafting boards, will have to wait for a relaxation in war requirements. Fairchild Aircraft Division, Fairchild Engine and Airplane Corporation.

Destructive Effect of High-Temperature Solders on Copper Wire

While conducting tests that resulted in the finding of a new method for clean-stripping Formex-type insulation from fine wire sizes (Nos. 36–44), Fairchild engineers explored the destructive effect of high-temperature molten solders on copper wire and worked out a preventive. The tests with small diameter copper wires show the need for rigid temperature control and, to a lesser degree, close attention to solder composition in the hot-tin dip method of tinning or soldering wires.

Conclusions reached indicate that high solder temperatures are more destructive to wire if the tin content of the solder is too high. This destructive effect also increases as the wire diameter becomes finer. This danger can be avoided by proper control and clean-stripping in the case of wires insulated with synthetic or other type insulation. Tests reveal positively that the life of a given wire is greater if lead content of the solder is higher for any temperature.

The investigation of the hot-dip solder method shows other factors. Synthetic resin-coated wire must be dipped, above a critical temperature of 932°F., into molten solder. Polyvinyl acetal insulation is transformed by the heat, and insulation in this action apparently serves as a flux to permit tinning of the copper wire in the same dipping operation. More positive and complete stripping and tinning are obtained at slightly higher temperatures, approximately 1,025° to 1,100°F. For example, in the small wire sizes of No. 29 H.F. (Heavy Formex) and No. 40 H.F. the action is completed in about 10 and 3 sec., respectively, both at about 1,050°F. This phenomenon in wire destruction is important and serious. Such reduction in diameter in hot-tin dipping means weakened leads, perhaps production losses either at the dipping operation or later in assembly, and an inferior product that fails in the field; this is especially true in the finer wire sizes of Nos. 34–40, or even finer.

Based on these initial observations, detailed tests were conducted by Fairchild engineers. The tests were to determine the time required for complete destruction of copper wire. The wire life or destruction time was measured accurately from the moment of entry into the solder. The solder was kept in a temperature-controlled, electrically heated cast-iron pot of 2-cu.in. capacity. Dross was scraped from the solder surface immediately before each test. Approximately 400 wire samples were tested. All tests have been plotted in curves, 1, 2, and 3 below.

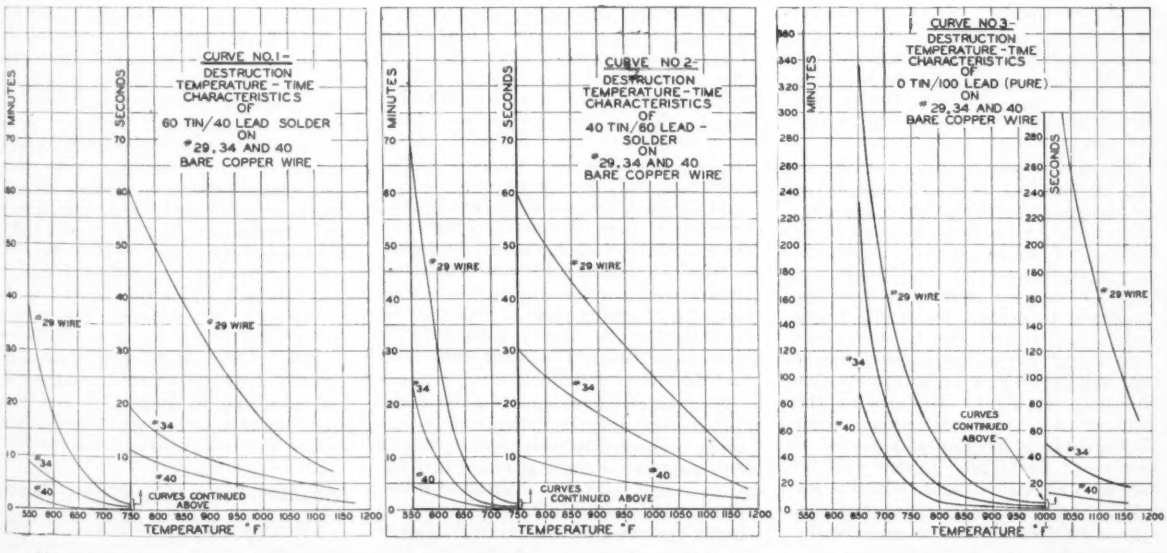
A review of these data leads to three major conclusions: (1) The life and diameter of any small to fine size copper wire in any solder is decreased with increasing molten solder temperatures. (2) The higher the tin content of tin/lead solder, the shorter is the life of a given wire in that solder for any given solder temperature. Unfortunately, however, an all-lead solder results in a considerably weaker solder joint than tin/lead solders. (3) For a given solder composition and solder temperature, the finer the wire size (diameter), the shorter is the wire life in the solder.

Further conclusions to the tests are: The best all-round solder of those tested appears to be the 40/60 combination, commonly referred to as soft solder. Other solders in this vicinity may offer even better properties. For certain other purposes, regardless of these findings, hard, or 60/40, solder may be best.

Some form of wire weakening or loss of tensile strength, broadly classified as embrittlement, may be imparted to copper wire from tin/lead solders in the 1,000°F. temperature range.

On the basis of these facts only, it is apparent that a low solder temperature should be used for tinning or making joints on wire sizes finer than approximately Nos. 30–32. Preferably, these solder temperatures should be kept either within 150° to 200°F. above the melting or liquid point of the solder used, or under 600°F. For Formex or Formvar coated wires a low-temperature insulation-stripping method other than the hot-tin dip method becomes necessary. Other methods, involving high temperatures, such as the gas-flame method, tend to introduce wire embrittlement and copper oxidation and are no better.

In summary, for the safety of the wire lead being stripped, the production assembly schedule, or the final assembled piece of precision equipment, it is important that the fine sizes (Nos.


CURVE NO.1 – DESTRUCTION TEMPERATURE – TIME CHARACTERISTICS OF 60 TIN/40 LEAD SOLDER ON #29, 34 AND 40 BARE COPPER WIRE
CURVE NO.2 – DESTRUCTION TEMPERATURE – TIME CHARACTERISTICS OF 40 TIN/60 LEAD – SOLDER ON #29, 34 AND 40 BARE COPPER WIRE
CURVE NO.3 – DESTRUCTION TEMPERATURE – TIME CHARACTERISTICS OF 0 TIN/100 LEAD (PURE) ON #29, 34 AND 40 BARE COPPER WIRE
MINUTES
SECONDS
#29 WIRE
#34
#40
CURVES CONTINUED ABOVE
TEMPERATURE °F

The destructive effects of high temperatures in soldering copper wires are clearly shown in the above curves. It is apparent that the greatest rate of change in destruction time with temperature change occurs on the range of approximately 550° to 750°F. for 60/40 and 40/60 solders, and 650° to 950°F. for pure lead. However, this is compensated for by several factors. The time required for tin dipping is short—a matter of seconds—compared with the destruction time, especially at the lower temperatures. The nearer to the melting or liquid point of the solder that this tin dipping is performed, the better, because the time spread is greater.

All curves clearly demonstrate that temperature increase has a tremendously nonbeneficial effect upon the destruction time. An unfortunate but important outcome of this analysis is that, for a given set of conditions, wire life decreases materially with decrease in wire size (diameter).

34-46) of synthetic-coated wire be stripped, tinned, and joined or soldered at temperatures at or under 600°F. Fairchild Camera & Instrument Corporation.

Central Fire Control for B-29

The central fire-control system used on the B-29 Superfortress was demonstrated in New York on December 8 under the auspices of the Army Air Forces Air Technical Service Command, Boeing Aircraft Company, and General Electric Company. It was reported that the gunfire control system has never before been used in airplanes, but is similar to that used in naval craft. The control is so arranged that any one gunner, except the tail gunner, can assume control of more than one of the bomber's five turrets at one time. The individual gunner has primary control of his own turret and secondary control of others. As many as three turrets can be controlled and fired simultaneously by a single gunner by means of the computing gunsight, which operates the turrets through remote control.

This remote-control mechanism makes it possible for the gunners to remain in comfortable positions inside the pressurized cabin, so that they are freed from the necessity of wearing bulky and heavy clothing and oxygen masks while flying at high altitudes.

The position of the gunners and the centralized remote control make it possible for the gunners to cover any possible direction from which attacking enemy planes may approach, each turret being able to swing in any direction through more than a hemisphere. This enables them to meet (1) attacks approaching from forward positions, in which only 3 sec. elapse between the time the attacking fighter is six blocks away until he has passed behind, (2) side attacks, in which the relative angular rate is so great that the guns must lead the enemy fighter by as much as 200 yards, or (3) slowly closing tail attacks that give the enemy fighter ample time to fire.

The gunner uses a sighting station to aim at and determine the range of the enemy fighter. It must permit a gunner, who has a comfortable grasp on its handles, to "track" a fast moving enemy fighter smoothly and accurately without the slightest stickiness or roughness to disturb his steady touch and throw him off. On the sight there is a trigger under the gunner's finger that will fire all guns on all turrets controlled by his sight. Mounted on the sighting station is the actual sight through which the gunner looks when he aims at the target. In this sight he sees a small spot of light, which is his aiming point. Whenever he puts this spot of light on the enemy airplane, he knows that his aim is correct.

Around the sighting dot is a circle of other small dots of light. The size of this circle can be changed by twisting the range control on his handles. When the gunner has his aiming point on the center of the enemy airplane, he adjusts the size of the circle until it just spans the length of the target. Sun or sky filters and a brightness control on the sighting light give the gunner a wide range of adjustment. With the proper settings, he can sight at any target, such as a plane coming at him almost directly out of the glare of the sun, or a plane coming at him out of the blackness of night.

A set of selsyns constitutes a part of the sighting station. Electric connections run from these selsyns to a similar set of selsyns on the turret. Whenever the gunner moves the sight, the selsyns on the sight and those on the turret compare automatically the line of sight with the line of fire. If a difference exists, an electric signal representing this difference between directions is fed into an electronic servo-amplifier. The servo-amplifier amplifies the signal it has received and computes which way the guns must be moved to bring them into alignment with the sight. It then applies electric current to the field of an amplidyne motor generator. In doing this, it makes the amplidyne motor generator generate a voltage that causes the turret-drive motor to run in the proper direction until the selsyns signal that the guns are lined up with the sight.

A gunner concentrating on "tracking" a fast-moving enemy airplane might swing the line of fire from his guns through parts of his own airplane. Automatic fire interrupters stop the guns from firing at the gunner's own airplane and relieve him of this responsibility. At the same time, however, these interrupters must be accurate enough to permit him to fire within inches of parts of his own plane, so that he loses the least possible fire coverage.

The B-29 computer was designed to solve automatically all of these problems and make the guns point to hit the enemy fighter when the gunner aims at it. The computer automatically calculates the parallax, windage, gravity drop, and lead corrections and then adds them together into a total correction. This total correction, which might be more than a total correction, which might be more than 10°, is superimposed in the sight direction signal that is sent to the turret and causes the turret to point its guns not at the target, but in a direction so that bullets will hit the target. The gunner does not have to guess at the correct gun-aiming point, which can be more than 500 ft. away from the target. He can aim right at the target and know that his bullets will hit.

Because all sight signals are transmitted electrically, more than one turret can be connected to these signals; thus, each sight can control as many turrets as are connected to it. Turrets can be transferred from one sight to another by simply operating a switch. In this way the fire power from all turrets can be distributed for overall protection or can be concentrated where it is needed the most. Fewer turrets can do the job. For these reasons, the five turrets, the five sighting stations, and the accessories are interconnected electrically to form an integrated armament system.

The nose gunner controls both the upper forward and lower forward turrets. The upper gunner controls the upper rear turret and can simultaneously control the upper forward when the nose gunner is not using it. The side gunners control the lower rear turret and they can also control the lower forward when the nose gunner is not using it. The side gunners can also control the tail turret if the tail gunner is not using his guns. The gunners set up these various control combinations with a few toggle switches; transfer of turret control between sighting stations is then automatic. The combination of control that is selected depends on the current enemy tactics being encountered, whether the B-29 is in formation or alone, whether it is day or night, and other factors. General Electric Company.

Type Eleven Rubber Deicers

It is reported that rubber deicers—the pulsating type that breaks off the ice as the rubber tubes expand and contract—are being installed on the Northrop P-61 Black Widow night fighter. A recent series of tests with this deicer was conducted on a B-24 Liberator bomber. Equipped with the deicer, the bomber was operated for more than a year on ice-hunting missions, during which it made its own ice artificially when icing conditions were not present in the atmosphere. The plane was not placed in a hangar during the test period but left out in weather conditions providing sun, sand, sleet, and rain, to give the deicers the severest kind of natural aging tests. In addition, they were operated almost half of the time the airplane was flying. When finally removed and inspected, it is stated, the deicers were found to be good for many more months of service.

The Type 11 deicer is credited by the manufacturer with many advantages over previous types. These include the following: the attachment edge is thinner, reinforcing strips are eliminated, and tubes are recessed, giving smoother cross section; new thin, lightweight fabric gives improved tear resistance; elimination of sponge filler and reinforcement strips reduces weight; the more effective use of fabric and rubber has resulted in greater compactness; more effective tube layout, made practical by the stronger, lighter materials, has improved the ice-removal efficiency; the new deicer is installed more easily, with less strain on the rubber, resulting in longer life and lowered maintenance requirements and costs. The B. F. Goodrich Company.

Mountain-Top Gales to Test Deicers

Affording almost continuous "icing conditions" and wind velocities that equal or approximate airplane speeds, the wind-swept summit of Mt. Washington in New Hampshire has been chosen as a testing ground for airplane deicers.

An airplane wing, mounted like a weather vane so that it will head into

the wind, has been erected on a tower 18 ft. above the summit of the 6,288-ft. mountain. On this wing are installed experimental deicer models powered by a compressor located within the tower. Goodrich technicians built the test rig and outlined the program, and the tests are being run by scientists from Mt. Washington Observatory on the mountain top.

Wind velocities as great as 231 m.p.h. have been registered there. Weather Bureau records showed that in January, 1944, there were 20 days in which wind velocity exceeded 100 m.p.h. and 25 days in which ice formation occurred.

In addition to the availability of winds and ice, the U.S. Weather Bureau scientists of Mt. Washington Observatory are also on hand with exact information as to temperature, wind velocity, icing rate, liquid content, ice density, and ice type.

The purpose of the Mt. Washington tests is to study further the physics involved in airplane ice removal. Ice removal research has always been hampered by the difficulty of reproducing, where they can be conveniently studied, the great variety of icing conditions experienced in flight. It is hoped through the Mt. Washington tests to add to the data accumulated through extensive wind-tunnel studies. The B. F. Goodrich Company.

Shell End Mills with Brazed-In Blades

Small standard shell-end mills with brazed-in blades made of Haynes Stellite cobalt-chromium-tungsten alloy are supplied with blades of either Haynes Stellite 98M2 or Star J-Metal brazed into a steel body. Diameters range from $1\frac{1}{4}$ to 6 in., with face thicknesses of from 1 to $2\frac{1}{4}$ in. These cutters, which are supplied ready for use, are used for milling aluminum, bronze, cast iron, brass, alloys, and some steels. Haynes Stellite Company, Kokomo, Ind., a unit of Union Carbide and Carbon Corporation.

"Live" Lathe Center

A "live" lathe center for handling heavy loads of up to almost 6 tons has a guaranteed tolerance of 0.0000 to 0.0005 in. To handle radial loads of up to 5,750 lbs. and thrust loads of up to 8,500 lbs., a special bearing arrangement is used. Two precision ball bearings in tandem support the spindle at the front and two angular-contact ball bearings, preloaded, support it at the rear of the housing. This arrangement also eliminates radial play and possible chatter. For positive protection of these bearings against the entrance of chips, dust, coolant, and other foreign matter, two sealing rings are used.

A feature of the design is the ease in redressing the point. The center is simply inserted in the lathe tailstock with the retainer plug removed. Then a small steel rod is screwed into the threaded hole in the end of the spindle of the line center. By rotating the spindle point with this rod and by using a toolpost grinder, accurate redressing of the points can quickly and efficiently be made.

This center, called the No. 6MH, is made with the No. 6 Morse Taper only. Shipping weight is approximately 20 lbs. Ideal Commutator Dresser Company, Sycamore, Ill.

Quick-Change Gear Turret Lathe

The Logan No. 840 quick-change gear turret lathe handles bar stock of up to and including $\frac{5}{8}$-in. diameter. Its design includes such features as the precision preloaded ball-bearing spindle mounting, adjustable gibs to compensate for wear of turret and cross slide, and self-lubricating bronze bearings at 35 points. Specifications call for bed ways ground to within 0.0005 in. of accuracy; total run-out of headstock spindle 12 in. from the bearing less than 0.001 in.; lead screw held to within 0.002 in. in 12 in.; and turret holes bored from the headstock.

The quick-change gear box provides 48 threads and feeds in either direction to the carriage. Simple adjustments of two levers make screw threads of from 8 to 224 per in. quickly available; by changing the 24-tooth stud gear for the 48-tooth stud gear supplied with the lathe, additional threads of 4 to 7 per in. are equally accessible. Similarly, longitudinal power feeds from 0.0015 to 0.1000 in. per revolution on the spindle may be obtained. Power cross feeds are at the rate of one-fourth of the longitudinal feeds.

Another feature of this lathe is its automatic apron, which operates from a spline in the lead screw through a worm-drive friction clutch for both longitudinal and cross feeds. For cutting threads an additional longitudinal drive operates from half nuts on the lead screw. A safety feature makes it impossible to engage both drives at the same time. Worm and gear operate in a bath of oil. Logan Engineering Company, Chicago.

Plating of Irregularly Shaped Parts

Through the use of a new adjustment anode rod it is possible to move plating anodes quickly and conveniently to the most advantageous position in relation to the work being plated. This permits faster plating of irregularly shaped parts, as well as rapid and positive adjustment to accommodate several types of plating work without electrically disconnecting the anodes from the source of power. Proper placement of the anodes, made possible by this adjustable rod, provides a more even disposition and finer texture of the plating material and reduces the amount of current required.

Designed for use with elongated, quantity-production plating tanks, the new installation consists of brackets welded, bolted, or riveted to the walls of the tank to which steel plates or arms, insulated on either side with phenol fiber, are pivotally attached. At the outer end of these plates or arms are swivel fittings on which are mounted annular clamps containing insulators that surround and support the anode rod. The insulators are formed in two halves so that they may be easily installed and clamped in place around the rod. Anode baskets containing chunks or balls of the metal to be deposited are hooked over and supported by the rod.

Current is supplied through a flexible cable attached to one end of the rod, while an insulated handle is provided at the other end to permit the operator to adjust the rod as he sees fit. The rod installation is of sturdy, simple design capable of supporting several hundred pounds of anode material, which can be moved with little effort to any position desired.

In use, the operator lowers the work to be plated into the tank and then, by means of the insulated handle, moves the anode rod to place the anodes in the most advantageous position for the parts being plated. When the plating is completed, the rods are moved apart, the plated parts are removed, new ones are placed in the tank, and the adjustment process is repeated. It makes little difference whether one batch is similar to another, and the whole adjustment process requires only seconds instead of the long periods of time consumed with previous rod-mounting methods. Moreover, at no time during the operation is it necessary to disconnect the rod from the source of power, and the lifting of anode material by the operator is eliminated. Designs for the adjustable rod will be made available to interested manufacturers of plating equipment under license. The Glenn L. Martin Company.

Pressure Gage for Testing Oiling System

Preoiling of engines on the B-26 Marauder prior to their initial start has been greatly improved by the installation of a pressure gage on the governor pad in the nose section. Since the oil is introduced under pressure through the aft section, any blocks in the oil system are immediately indicated on the gage. A correct reading on the gage indicates that all parts are properly lubricated.

Installation and removal of the gages can be accomplished in a few minutes; this time is more than compensated for by the protection provided against failure and damage to valuable equipment likely to be caused by improper lubrication. The Glenn L. Martin Company.

Chemical-Control Laboratory

A special laboratory that maintains a constant control over anodizing, plating, and all other processing solutions is saving labor and contributing to the uniformly high quality of processed parts. The sole function of this laboratory, which is an integral part of the Finishing and Plating Department, is to stand watch over the 40 or more chemical baths needed in preparing and processing a wide range of parts made

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of various metals and their alloys for the protection of Martin bombers and transports against corrosion. Samples are taken from each tank daily and analyzed for various properties. Anodizing baths, for example, are checked for hydrogen concentration, current density, total chromic acid, free chromic acid, specific gravity, etc., while plating baths are analyzed for the amount of metal in solution and similar characteristics.

The laboratory also runs sample parts through the various baths each day for visual inspection of the film or metal deposit. By taking over the problem of solution control and seeing that all solutions are maintained at constant concentrations at all times, the laboratory has made it possible to place the plating room on a highly standardized production basis despite the wide variety of work handled and the use of many semiskilled employees. The Glenn L. Martin Company.

Improved Methods for Installing Deicer Boots

Two convenient tables, a set of permanent templates, a pneumatic perforator, and mechanical stretching devices replace previous laborious hand-punching and stretching methods for the installation of deicer boots on the PBM Mariner. The new technique is reported to have reduced the time for this operation from 8 or 9 hours to less than 2 hours.

The two tables, each about 30 ft. long by 3 ft. wide, are set up adjacent to the wings on which the boots are to be installed. To them are attached the permanent notched templates, the notches of which serve to guide the pneumatic perforator. These notches are matched to the Riv-Nuts located within the leading edge of the wing, making it unnecessary to check the boots after perforation, and at the same time rendering the perforated boots interchangeable.

There is adequate space on the tables and the templates for the inner wing and stabilizer surfaces that are arranged around and on the larger templates. These smaller templates are held in place with Camloc-type hold-downs and can be readily removed when not in use and stored on racks provided under the table. This eliminates the need for extra tables for the smaller surfaces and saves floor space.

Under the new procedure the boot is first unrolled on the template, flattened, and clamped at both ends. Holes are then punched with the perforator, following the notched pattern of the template, (and eliminating all need for marking). The boot is then removed from the table and either taken to the wing for installation by stretching over studs inserted in the Riv-Nuts or rolled and stored.

New and faster methods are likewise used at the point of installation. Here it had previously been necessary to beat or snub the boot into place, generally with the heel of the hand. To eliminate this two stretchers have been devised which have already proved their value.

The first is a lever-type device inserted through the mooring lug in the leading edge and then clamped to the boot. Pulling the lever stretches the boot and draws it into place. The second type of stretching device employs two cranks secured to a piece of Masonite that is fastened to the inboard nose rib and front spar. The cranks are arranged independently to draw taut wires attached to fiber block clamps that are clamped to the boot. Cranking stretches the boot, and the cranks can be locked at any time by means of set-screws in the crank housing.

Since the introduction of the tables and auxiliary equipment, not only has perforation and installation time for Mariner deicer boots been drastically reduced, but it has become possible to perforate the boots in advance of actual needs and either roll them for storage aboard ship or attach them to the wings, according to Navy requirements of the moment. The Glenn L. Martin Company.

Mustang as a Photoreconnaissance Plane

The North American P-51 Mustang is being used at the war fronts as a single-seater photoreconnaissance airplane because it can carry photographic equipment in addition to a full complement of machine guns and bombs. The photoreconnaissance version of the Mustang is identified by the Army Air Forces as the F-6.

A variety of cameras can be installed in a special compartment built into the fuselage of regular production models after they leave the assembly lines. The location of the camera enables the Mustang to obtain both oblique and vertical photographs.

The Mustang retains its six machine guns and normal bomb load or long-range fuel tanks to increase its effectiveness on reconnaissance flights deep into enemy territory. If necessary, the F-6 Mustang can fight its way to a target area, photograph the area, bomb the target, photograph the bombed area, and effectively deal with enemy aircraft on the return flight to its home base. North American Aviation, Inc.

Army-Navy Aircraft Rheostats

Two new approved Ohmite power rheostats for aircraft are made in accordance with Army-Navy Aeronautical Specifications AN-R-14a. They are designed to provide uniform electrical and mechanical control and dependability under all operating conditions of heat, cold, humidity, altitude, shock, and vibration.

These new aircraft rheostats are reported to be lighter than the allowable weight specified. They meet the salt-spray corrosion test and other critical tests and operate satisfactorily in the temperature range from −55° to +70°C. They are made in two sizes Model "J" 50-watt and Model "H" 25-

watt, and are linear or taper wire-wound in various resistances with "off" position, as required. Ohmite Manufacturing Company, Chicago.

Fiberglas-Resin Sheets for Lining Cargo Spaces

Cargo spaces of transport planes are being lined with thin, strong sheets consisting of layers of Fiberglas cloth bonded and impregnated with a contact-pressure, thermosetting MR-type resin. The lining protects the fuselage skin against contact with heavy items of cargo during loading and unloading.

The Fiberglas-resin sheets, $^1/_{16}$ in. thick, do not expand or contract under the influence of temperature and humidity changes such as are encountered by planes flying at varying heights. The finished sheets are manufactured by the Plastics Division of Continental Can Company. The Fiberglas cloth, which provides the strength element, is manufactured by Owens-Corning Fiberglas Corporation, Toledo, Ohio.

Aircraft Brake Intensifier

The aircraft model of the new Univac brake intensifier has been designed to provide a unit for power braking on airplanes to permit faster braking action and lower pedal pressures. The intensifier is particularly suitable for medium-size aircraft, with special installations available for planes weighing up to 30,000 lbs.

The unit, operating in conjunction with a Pesco vacuum pump mounted on the engine, produces the desired braking pressure at a pedal force of only 50 lbs. The unit is connected anywhere in the line between the master cylinder and the wheel brake. It is completely self-contained, weighing only 5 lbs. A minimum of piping is required and no levers or rods are necessary.

The assembly consists of a vacuum-suspended piston connected to another piston in a hydraulic cylinder. When the pilot operates the master cylinder in his hydraulic-brake system, thereby producing a pressure in the brake lines, the pressure so produced shuts off the vacuum and admits air to one side of the piston. This moves the piston in the hydraulic cylinder, which forces fluid into the brake lines and increases the line pressure. A control piston coacts with a vacuum-and-air valve so constructed as to give an exact ratio of input master-cylinder pressure to brake-line pressure. This ratio may be approximately 4 to 1. The pilot is relieved of taking the entire brake reaction against his foot. The reaction gives the pilot a constant "feel" of the magnitude of the braking forces being applied and provides a controllability of those forces comparable to the ease of control encountered in passenger cars equipped with hydraulic brakes. Pesco Products Company, Division of Borg-Warner Corporation.

Free-Air Thermometer

A new free-air thermometer is said to be ruggedly built, easily installed, accurate, and able to withstand prolonged vibration under service conditions.

A special sun shield insures accurate readings even when the bulb is exposed to direct sunlight. As reported, this thermometer was originally designed for and supplied to the Army Air Forces. Scott Aviation Corporation, Lancaster, N.Y.

Hot-Dope Spraying

The Thermotite system is designed to provide a constant supply of hot dope at the point of spraying. It includes a simple arrangement of heating coils, pressure tank, air pump, and spray gun.

The component parts of the applicator are (1) a standard pressure supply tank to hold the dope; (2) a unit, consisting of a steam-heated hot-dope reservoir and an air-driven circulating fluid pump to return the dope to the unit; (3) dual fluid-hose lines, one from the unit to the spray gun, the other from the spray gun through the circulating pump that returns unused dope to the unit heater tank; (4) accessories including steam-pressure reducing valves; low-pressure condensate trap; operating valves; dope pressure and temperature gages; steam control gage; and inlet and outlet connections for steam, air, and dope; (5) a steel cabinet, adequately ventilated and drained, which contains the entire assembly.

Special Thermotite dope at full body is placed in the pressure tank at room temperature. Air pressure at 45 lbs. is applied to the pressure tank, forcing the dope into the heating reservoir where a cylindric copper coil heats the dope to a predetermined temperature. Steam at $3^1/_2$- to 5-lbs. pressure is used as a heating medium. The air pressure at the dope tank continues forcing the material out of the heating chamber and through the hosing to the spray gun.

The flow of dope and the pressure used is adequate to meet the usual spray-gun consumption, and as surplus dope reaches the gun it is bypassed through the recirculating hose line from the gun through the air-driven pump and returned to the heater shell.

Predoped aircraft protective fabrics are first carefuly ironed, then impregnated with nitrate dopes and calendered. Fabrics pass through the coating machines as many as three times, and the weight of the film deposited is carefully checked at intervals on each run. The fabric is under constant laboratory control for "windows" (bubbles in the interstices of the fabric) or other faults.

Although it is generally assumed that the system is most effective when used with predoped fabrics, it is also reported to produce excellent results when used on raw fabric. The number of coats required may be reduced by as much as one-half when the elevated-temperature system is used. Sherwin-Williams Company, Cleveland.

New British Sea-Rescue Aircraft

Britain's new amphibian aircraft, the Supermarine Sea Otter, has been in operation in rescuing air crews from the sea after forced landings on the return flight from bomb raids on Germany. It is carrying on the air-sea rescue work that was done by its predecessor, the Walrus.

The Sea Otter was basically a naval design of aircraft, but it has so far been used chiefly on Royal Air Force rescue duty. Its main difference from the Walrus is its employment of a tract instead of a pusher propeller. The engine is a Bristol Mercury 30 radial, air-cooled unit of 870 hp., which drives a three-blade Rotol constant-speed propeller. Total weight is approximately 10,000 lbs., but no performance details have so far been released.

Among the less noticeable differences between the Walrus and the Sea Otter are the greater length of the Sea Otter's nose, the improved form of the hull, and the higher top line from wing roots to tail. These modifications have materially increased the amount of hull space for crew and equipment, as well as aerodynamic and hydrostatic characteristics.

Although the two airplanes broadly resemble one another, they have in common only 300 parts of a total of nearly 8,000. This difference indicates the degree of redesigning that turned the Walrus into the Sea Otter and justified the change of name.

Most of the changes were made in the hull. The wings remained the same. These have wooden ribs supplemented at intervals by metal box ribs built up on stainless-steel main and secondary spars. The upper wings are fabric-covered with the exception of the leading edges, which are covered with stressed plywood. The lower wings have stressed-plywood covering from wing roots to outboard of the bomb racks, the remainder being finished in fabric.

Two bomb racks, each capable of carrying bombs or depth charges, are fitted beneath each of the lower wings, and small bombs can also be carried on racks inside the wings. Wells made of stressed-skin plywood in the lower wings house the wheels of the hydraulically operated landing legs when retracted. Main fuel tanks are carried in the upper wings, close to the roots.

The wings are designed to fold and are hinged at the rear spars. The mechanism that holds the wings in flying position is a simple but safe bayonet fastening, locked by a lever that is held firm by a spring-loaded bolt. When folded, the wings are secured at the tips by a light but rigid clamp near the tail. Release is by means of a lever-operated cable under the pilot's control. An indication of the strength factor of the Sea Otter's wings is provided by the fact that they are stressed for dive bombing. In this they follow the Walrus' precedent.

Standard armament consists of three hand-operated 0.303-in. machine guns of the Vickers "K" type, one in the

nose and two aft on a single mounting. All three are neatly stowed inside the hull when not in use. The hatch covers are made in three sections, which when raised (by means of a hand-operated worm gear) fold in such a way that they form an effective windshield for the gunners. Pilot, navigator, and radio operator sit one behind the other on the port side, leaving a clear gangway on the starboard side.

As with the Walrus, the Sea Otter has spools for catapult launching. With the slightly wider hull, the forward spools do not project from the sides as they do on the Walrus. These spools, and many other hull and wing fittings, are of stainless steel. The Sea Otter is stressed against a catapult acceleration three times greater than any it is likely to encounter.

Extensive use is made of plastic materials for internal fittings. Among the items made from various types of plastics are stowages for maps and charts, first-aid kits, sea markers, flame floats, dinghy, Thermos flasks, and signalling lamps. Deicing fluid tanks are also made of plastics. These parts have proved reliable under exacting conditions. To give the Sea Otter additional range a special tank, shaped like a chair and upholstered, is substituted for the navigator's seat when necessary.

Most of the work of redesigning the Walrus was done by its original designers, Vickers-Supermarine. This company, however, had by the end of 1941 higher priority commitments that prevented their accepting a building contract for the Sea Otter. Production was therefore passed over to Saunders-Roe, Limited.

Specifications are as follows: wing span, 46 ft.; length, 39 ft. 4 3/4 in.; height (tail down), 16 ft. 2 in.; wing area, 610 sq.ft.; weight, approximately 10,000 lbs. The Society of British Aircraft Constructors, Ltd.

Small Toolroom Lathe

The new South Bend 9-in. toolroom lathe is the first offered by the builder in this size. This lathe has a 9 1/4-in. swing and takes 22 in. between centers. It has a maximum collet capacity of 1/2 in., and a 3/4-in. spindle bore.

The 12 spindle speeds range from 41 to 1,270 r.p.m., with back-gear drive for the lower speeds. A quick-change gear box permits cutting of 48 pitches of screw threads, 2 to 224 per in., and provides 48 power longitudinal feeds and power cross-feeds. The lathe is equipped with a handwheel draw-in collet attachment, collet rack, taper attachment, thread dial indicator, thread-cutting stop, large and small face plates, and micrometer carriage stop. Additional attachments are available that simplify the machining of special classes of work. South Bend Lathe Works, South Bend, Ind.

A Push-Pull Aircraft Circuit Breaker

The Class 9311 Type A push-pull circuit breaker provides both switching and protection similar to toggle-type breakers. It also guards against accidental or careless operation of vital circuits. A definite pull action is required to open the breaker manually, thus providing a manual means of operation for servicing of aircraft on the ground. The manual reset button, black at top, is provided with a red hand to indicate trip in daylight and a luminescent band to indicate trip in darkness.

The bimetallic trip element gives time-limit protection against small momentary overloads, as well as instantaneous protection on heavy overloads and short circuits. Each breaker is calibrated and factory sealed. After tripping it is only necessary to push the reset button down to its farthest position.

The Class 9311 circuit breaker is available in sizes 5 to 50 amp. The unit is built in accordance with AN specifications. The device is of the nontripfree type and all units are equipped with luminous indicating rings. Square D Company, Regulator Division, Detroit.

Automatic Die-Opening Cable Swager

The Standard cable swager has been redesigned into a fast, automatic die-opening and automatic feeding unit, requiring only 3 sec. for each complete operation. It is reported that the new machine has increased the production rates obtained in the attachment of fittings to cable by as much as 15 times. The machine makes possible a one-man operation and eliminates the necessity for removing the dies for each cable-swaging operation using large end fittings.

This cable swager utilizes the rotary swaging action for working in the shank metal of the fitting around the cable strands, but the operation is simplified by its hand control for opening and closing the dies from the front of the machine while it is running at the normal flywheel speed. The clearance when the dies are opened is sufficient to accommodate all standard types of fitting attachments.

The cycle of operation consists of passing the fitting that is loosely hung over the end of the cable through the open dies into the adjustable feed socket. The cable end is held firmly against the bottom of the fitting, ready for swinging the handle on the door front to a vertical position to start the swaging action. The foot treadle is released and the work is moved automatically through the dies to the completion point as set for the particular length of shank fitting used. The work moves from back to front in this swaging action. The dies are opened by making a quarter turn upon this same lever and the attached fitting is removed to complete the cycle. Four sizes of Standard cable-swaging machines are offered to handle cable sizes of from 1/16 to 1 1/2 in. The Standard Machinery Company, Providence, R.I.

Stinson Voyager 125

A new Stinson airplane was demonstrated recently. Called the Voyager 125, this family cruiser is the first post-war light plane designed by the Stinson Division of Consolidated Vultee Aircraft Corporation.

Powered by a 125-hp. Lycoming engine, the new Voyager cruises at 112 m.p.h. and has a range of 470 miles. It can carry two passengers in addition to the pilot, with ample space for baggage provided beneath the back seat. Comfort and ample space for both passengers and baggage are said to be the primary considerations in the interior design, while safety in performance and operation is stressed in the engineering design.

Production of this aircraft is expected to begin as soon as wartime restrictions are removed.

Specifications of the 125 are given as follows: engine, Lycoming 125 hp.; wing span, 34 ft.; fuselage length, 23 ft. 6 in.; gross weight, 1,875 lbs.; maximum speed, 123 m.p.h. at sea level; cruising speed, 112 m.p.h. at 83-per cent power; fuel capacity (maximum), 40 gal. or 4.2 hours or 470 miles; rate of climb, 750 ft. per min. at sea level; service ceiling, 14,000 ft.; take-off run, 545 ft. with flaps down; landing roll, 265 ft. with flaps down; stalling speed, 51.5 m.p.h. with flaps down; weight empty, 1,118 lbs. Stinson Division of Consolidated Vultee Aircraft Corporation.

Elastic Fiber for Compound Curves

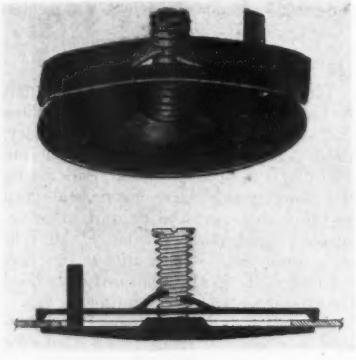
When it was discovered a short time ago that flat sheets of phenol fiber could be reheated to within a few degrees of the blister point and then, by being pressed in inexpensive wooden molds, be permanently reset in various intricate shapes, engineers went to work on the development of a special phenol fiber that would have the necessary characteristics to permit compound curves and relatively deep draws without weakening the structural strength of the finished product.

The result is the development of phenolastic fiber. This new material is essentially a fabric-base phenol fiber as it has always been made, but with the added advantage of greater elasticity obtained by a special weave in the base material of the fiber and rearrangement of the resin formula and coating procedures.

Starting with a flat sheet of phenolastic fiber, it is stated to be possible to change the shape of the fiber to conform to almost any bend, curve, or draw desired, within 3 min. or less. Among the advantages claimed for this new material are speedy production, reduced costs of dies, saving in transportation and storage costs for manufacturers who do their own forming from the flat sheets, and better performance for parts formerly made of materials that were structurally weakened by bending or drawing. Taylor Fibre Company, Norristown, Pa.

Cover Plates

Speed Nut cover plates were first designed for patching bullet holes in airplanes. Now their industrial applications include removable covers for inspection doors, access holes, and vent holes. They are also used to seal holes left after alterations or removal of equipment. They are attached from one side by sliding one end of the Speed Nut into the hole, centering the cover plate over the hole, and tightening the screw. The turned-down tab on the cover plate prevents the Speed Nut from turning while the screw is tightened. To remove, it is necessary only to loosen the screw and slip the Speed Nut out of the hole. The cover plates are made of SAE 1060 steel, heat-treated, Parkerized and coated with zinc chromate primer. Three sizes are now available to fit a wide range of panel thicknesses and to cover holes of 29/32-, $1^1/_8$-, and $1^3/_8$-in. diameter. Other sizes are made on special order. Tinnerman Products, Inc., Cleveland.



The Tinnerman Speed Nut cover plate.

Alternating-Current Gyro Motors

A program is under way to develop a.c. gyros for important applications in flight-control devices, bombsights, and similar computing devices. The largest of the present a.c. gyros is one with a rotor 5 in. in diameter operating at 12,000 r.p.m. from a 400-cycle, three-phase supply. This is a part of an automatic pilot. The smallest of this type of a.c. gyros is $2^3/_{16}$ in. in diameter, which replaces an air-driven gyro in a computing sight.

Although "inside-out" squirrel-cage motors are used for some of these gyros, most of them are "inside-out" hysteresis motors. The usual rotor is part of the flywheel and rotates outside of the air gap, the polyphase stator being wound inside of the air gap.

Hysteresis motors require no squirrel cage, but instead employ discs of permanent-magnet steel for the roto. Magnetic hysteresis caused by the rotating field causes the rotor to accelerate and finally fall into synchronism. The current drain changes little in passing from locked-to synchronous operation, a considerable advantage when these gyros are driven from small inverters. Westinghouse Electric and Manufacturing Company.

Brake for Airplane-Control Motors

A direct-current motor turning at 16,000 r.p.m. can be brought to a standstill in $^1/_{15}$ sec. by a new brake developed by Westinghouse. The armature turns only eleven revolutions after the brake is applied. This is done by an electromagnetically controlled friction brake that operates without disengaging the motor rotor from the load.

A disc of special friction material, splined to the shaft, turns between two stationary brake shoes that tend to close under spring pressure but are held away by electromagnetic coils as long as power is applied to the motor. Opening the line switch allows the springs to force the shoes against the spinning brake disc and affords virtually instantaneous stopping. By applying pressure equally to both sides of the shoe, the end-thrust effect on the motor bearing caused by braking is reduced to an inconsequential figure. For use on a special propeller-feathering motor one of these brakes was required to withstand an ambient temperature of 200°F. and a vibration test of 50 times the acceleration rate of gravity, imposed 240 times per sec. for 50 hours. In another test the brake was still operable after a test run of 10,000 operations. Brakes of this sort are applicable to many motor-driven devices in airplanes to permit more exact operation of distant controls or to prevent injury to the motor or the device resulting from jamming against stops caused by motor momentum. Westinghouse Electric & Manufacturing Company.

A Billion Stresses in a Hurry

Test machines have been devised that considerably reduce the time needed to test the new high-temperature alloys used in steam turbines, jet-propulsion units, and other high-temperature machines. At room temperature the story of endurance of a metal is usually told in 10,000,000 cycles of stress. But at elevated temperatures, the curve of waning endurance continues downward for several hundred million cycles. By ordinary means it takes years to stress an alloy sample held at 1,500°F. one-quarter billion times. The special machines can do this testing job in a month.

The test piece is clamped in a furnace that maintains the desired temperature. Through the clamping structure a stress is applied 120 times per sec. by two stator coils connected to a two-phase, 60-cycle supply line. The entire system is mechanically tuned to resonance at this frequency in order to minimize the driving force necessary. This tuning also serves another highly desirable purpose. Research engineers want to see the specimen after the first tiny crack occurs, not after the complete failure of the sample. With this device the machine automatically stops when the first crack appears. Thus, a sample can be placed in the tester, heated to the desired temperature and the test started and allowed to run without attention for weeks or months until failure begins. Tests of high-temperature alloys up to a billion applications of stress are reported to have been made in 100 days. Westinghouse Electric & Manufacturing Company.

An Absolute Altimeter

An absolute altimeter, now in quantity production, is designed to tell the pilot how far the plane is above a mountainside or other unseen obstacle at night, during fogs, and in storms. It is based on radio principles and is a development of the engineers of several organizations, including the Radio Corporation of America, and the Navy. The system requires a special instrument developed by Westinghouse. This is an accurate d.c. milliameter of the circular-scale type that is temperature-compensated to operate at temperatures from −67° to +18°F. Over the normal range of temperature the accuracy is within one per cent. The instrument has two scales, 0 to 400 ft., and 0 to 4,000 ft., selected by turning an external switch. Only one scale shows at a time behind the windows in the dial face, eliminating any possibility of error by the pilot reading the wrong scale. The instrument also combines the master control switch for the entire absolute-altimeter system.

The absolute altimeter provides information as to the distance to the nearest solid object, such as level ground beneath the plane, or a hillside or mountain. For altitudes within the region of 10 to 400 ft. this indication is reported to be accurate to within 5 ft. of the actual distance. Westinghouse Electric & Manufacturing Company.

Portable Vibration Recorder

The Vibrograph is a small portable vibration recorder that is about the size of an ordinary box camera. It weighs less than 9 lbs. and requires no power connection. It makes a permanent record of vibrations over the range of 600 to 15,000 cycles per min., and amplitudes as low as $^1/_{10,000}$ in. or as great as $^1/_{16}$ in. The record and a timing wave are drawn by a stylus on a transparent plastic tape only 1 in. wide, which is viewed by a low-power microscope.

The instrument achieves mechanical amplifications of about eight, using the same principle by which earthquakes are recorded. It consists in the main of a frame containing a mass suspended by a weak spring. A pointer attached to the mass indicates relative motion between the frame and mass when the frame is applied to a vibrating body. Westinghouse Electirc & Manufacturing Company.

Hot-Forming Molded Laminate

A new plastic, known as Micarta 444, is credited with combining the desirable molding properties of thermoplastic materials and the good physical char-

acteristics of thermosetting materials. A modification of the resin in standard Micarta causes the substance to soften when hot, as do thermoplastic materials, but at a much higher temperature. This temperature is about 300°F., enabling the new Micarta to be heated and pressed into deep-drawn and complicated shapes. The pressures are lower—about 50 to 100 lbs.—and the time much shorter than required for curing of thermosetting resins. Dies can be made of hard wood or of thermosetting laminates, making the manufacture of a relatively small number of parts from a single die economical.

When cool, the product has the strength and freedom from embrittlement characteristic of many thermosetting materials. Used in aircraft for nonstructural and semistructural members, a weight-saving of some 50 per cent over a comparable volume of metal is reported to have been achieved. In addition, a considerable saving in labor has been made. In one particular operation, a single sheet of formed Micarta replaced an airplane part formed of four separate pieces of aluminum. The aluminum sections were welded together, requiring 40 in. of weld and using a total of $1^1/_4$ man-hours to make the aluminum part. The formed Micarta part requires 19 min. to produce and weighs only about one-half as much. These savings indicate the possibilities afforded by the material in applications where good insulating qualities, high impact strength, and good thermal stability are required. Westinghouse Electric & Manufacturing Company.

Electronic Timer Gives Uniform X-Ray Exposures

A photoelectric X-ray timing device makes possible the obtaining of uniformly dense photofluorographic exposures with an overall increase in operating efficiency of 100 per cent. The device times each exposure properly, quickly, and automatically. In effect, it measures the light leaving the fluorescent screen on which the X-rays cast the object image. When sufficient light has left the screen for satisfactory film exposure, the photoelectric tube that scans the screen actuates a relay, opening the X-ray circuit and terminating the exposure.

The basic component of the Phototimer is the so-called phototube camera consisting of a lens that scans the fluorescent screen, a photoelectric multiplier tube, and a condenser-thyratron-relay system. The phototube camera is mounted beneath the photofluorographic hood and "sees" the object image on the screen "seen" by the photographic camera at the apex of the hood. Light from the screen initiates a small current in the photoelectric tube, which is greatly amplified. The output current charges the condenser until the proper ionization voltage is reached when the thyratron actuates the relay that opens the X-ray and terminates the exposure. Proper choice and design of circuit constants enable the timer to maintain the correct exposure factor for uniformly. dense film exposures. Westinghouse Electric and Manufacturing Company.

Photo Courtesy Westinghouse Electric & Manufacturing Company

To prevent uneven shrinkage after heat-treatment of the new engine mounts for the Douglas A-26 attack bomber the ring is immersed in the quenching bath in a horizontal position.

Engine Mounts for A-26

A new type of engine mount for Army airplanes, now used in the Douglas A-26 twin-engined attack bomber is being made at the Mansfield Works of the Westinghouse Electric & Manufacturing Company. Designed by Douglas Aircraft Company, the new mount reduces the time required for the changing of engines from 18 to 4 hours. It weighs 100 lbs. and fits into the nacelle section on the wing of the new bomber. It is attached to the engine and wing at six points.

The engine mount calls for a $^1/_{32}$-in. contour tolerance; its closest tolerance is 0.0015-in. Douglas engineers designed special gages to check the accuracy of the workmanship.

In addition to the rapid engine-changing feature of the new mount, it is designed to permit a mechanic to crawl inside it through a special doorway to make repairs and adjustments to the rear section of the engine. Westinghouse Electric & Manufacturing Company.

4,000-Hp. Engine Test Cells

The Wright Aeronautical Corporation has opened at its Wood Ridge, N.J., plant the first of 16 new test cells structurally capable of accommodating engines up to 4,000 hp. For the present, this cell will be used in the testing of 2,200-hp. Cyclone 18's that are being constructed for Boeing B-29 Superfortresses.

The new cells form a separate unit and are several hundred feet from those that have been in use since January, 1943. The control rooms are air-conditioned and soundproofed, and the instrument panels have been redesigned to offer better visibility and more accurate registration of data. All cells are equipped with automatic fire-fighting systems that can instantly flood the chamber with carbon-dioxide gas.

Catwalks give direct access to the engine in each cell from the second-floor control room and the floor of the test cell itself. Sections of these walks are retractable and are drawn away from the engine while it is running. Wright Aeronautical Corporation.

Portable Corrosion-Preventive Service Carts for Aircraft Engines

New equipment for corrosion-proofing of aircraft engines is known as "Corrosion Preventive Service Carts." This equipment is used to circulate a hot mixture of lubricating oil and rust preventive through aircraft engines in an operation sometimes referred to as "pickling." The engines are treated in the test cells following the final test run.

A modification of these units has been furnished to aircraft builders for preoiling aircraft engines after they have been installed in the frame. For this application, the carts are designed with sufficient electric heaters to provide warm oil under proper pressure to the engine and propeller hub. Because a small quantity of oil remains in the engine after each application, a float is provided for indicating the level. Means are incorporated in the design to insure that oil does not uncover the heaters. Youngstown Miller Company, Sandusky, Ohio.